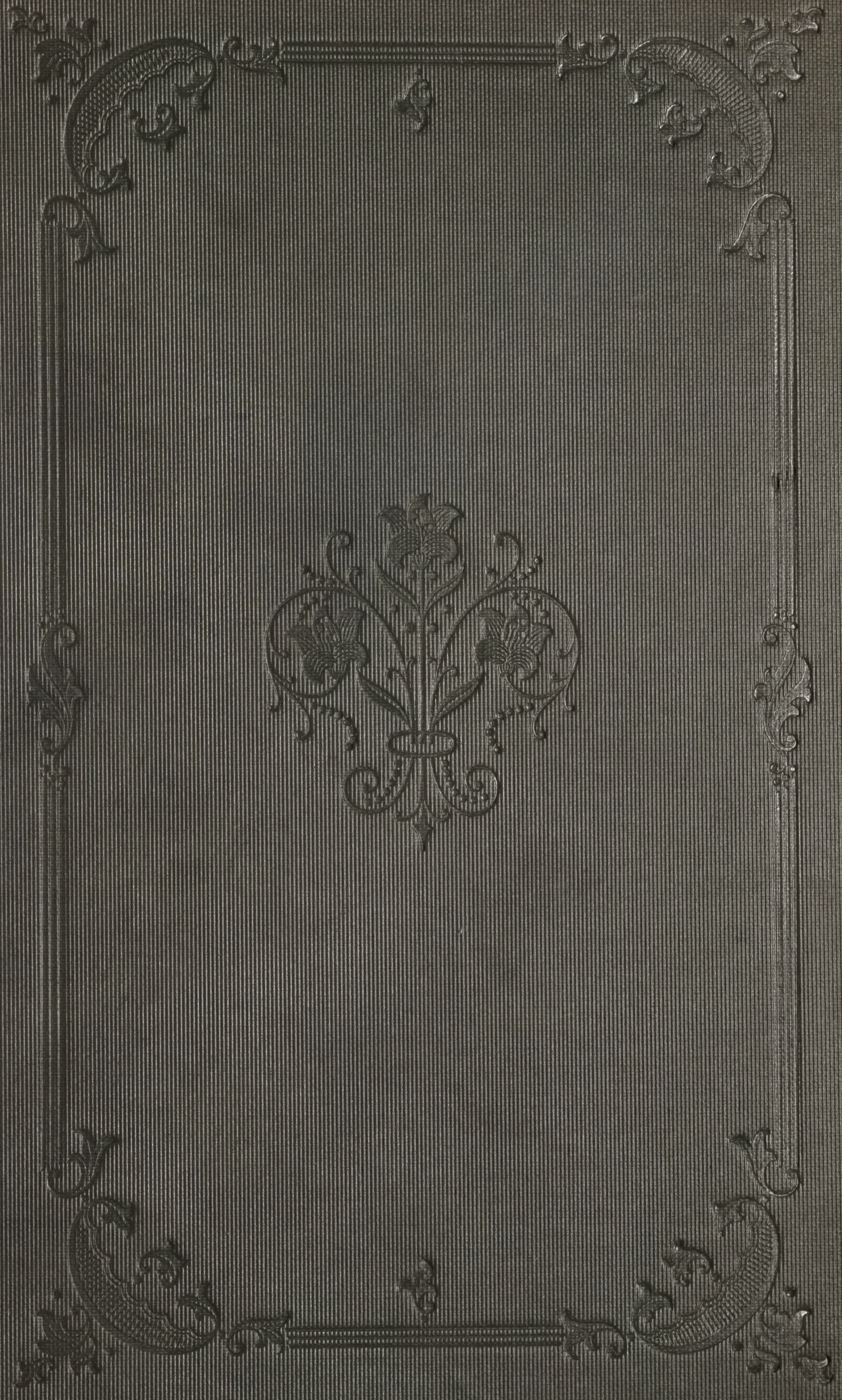






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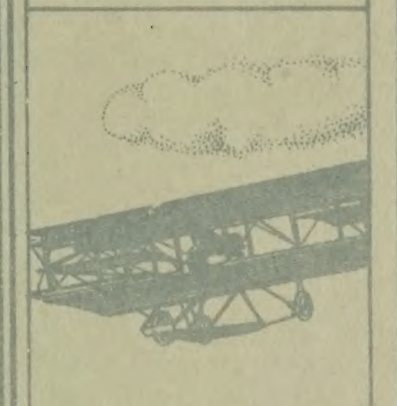
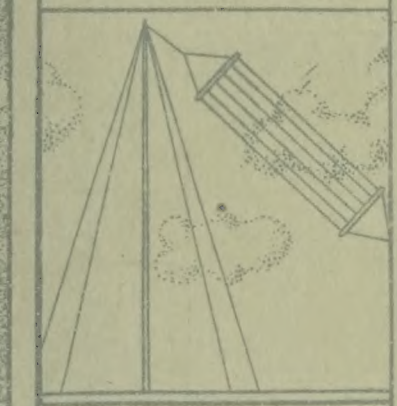
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Come, wander with me,' she said,
has written for thee;
Saying: 'Here is a story-book thy Father
the child upon her knee,
"And Nature, the old Nurse, took

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And read, what is yet unread
in the manuscripts of God.’ ”

—*Longfellow.*



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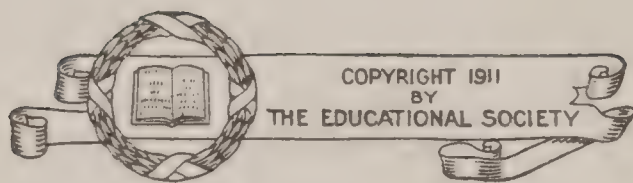
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INTRODUCTION

HE other volumes of this series have been, for the most part, devoted to a scientific view of the world and its products. They have dealt with things in general from the standpoint of the scholar, or scientific man, who has, after collecting a great mass of facts by hard study, learned the rules and laws that govern them, and so formed the observations into a systematic body of knowledge, or a science.

In this volume plants and animals have been treated entirely as they relate to everyday life of mankind. We have considered the world of nature as if it were a great storehouse, or storeroom, filled with objects meant for the use and benefit of men, women, and children. Speaking in common terms, the world of natural objects may be classified under three heads, animal, vegetable, and mineral; the third class being those things which, though they obey certain laws, yet show no signs of mind or will power. In this volume we have dealt only with the first two classes, and have told about these the facts that have made them of direct benefit to us in supporting our daily life, and of increasing our comfort and pleasure in living. To put the idea in the simplest possible words, we have here told of the uses of plants and animals to mankind.

We have already spoken of the world as a great storehouse for the benefit of mankind. To continue

this figure of speech, we may liken this world to such a storehouse turned over for the use of persons who at first did not know what could be done with the treasures it contained; for in the remote past mankind used but a few of these living treasures and these for few purposes. But as time went on, and the wants of mankind increased, so did the means of satisfying them, and so did the discoveries of possible uses for the rich provision nature had made. The civilized man has learned to extend his wants, together with the means of gratifying them, throughout the entire world. From every region he causes to be brought to him whatever may add to his comfort and his pleasure; in return, he gives either his services or the products of his own country.

There is now an endless seeking for new pleasures, new comforts, new sensations—for better food, richer clothing, and even for rarer or choicer objects to excite admiration, or to awaken envy.

One can see, from this brief statement, that there is hardly anything in the life of mankind that might not find place, directly or indirectly, in this volume. Consequently, it has been necessary to select carefully the subjects presented in it, in order to give the young reader a general idea of the plants and animals that have been found most useful, and have contributed most to our improvement upon the earth. The subject has been divided into two main divisions; plants have received treatment first as foods; secondly, as giving comfort and pleasure. Then the same method of treatment has been applied to animals. The question of food is, of course, a narrower one than the question of general comforts and

pleasures derived from plants and animals. But the two branches of the subject are somewhat equalized when it is considered how great a variety of food may be prepared, and how closely this subject comes to our daily life. In civilized countries, even those who live simply must call upon nearly every quarter of the earth to furnish their tables. On the other hand, although the comforts and pleasures found in plants and animals are infinitely varied, yet only a few of these are enjoyed by any one class of people. Hunting, field sports, fishing, even the enjoyment of pets are diversions that come to comparatively few of us, and are no longer general experiences. So the division made between these two classes is a fairer one than it would seem when first considered.

The effort has been to give most space to those matters which should be well known to everyone. Young people have, at best, so great a mass of facts to learn, that they are forced to choose the more important, and to neglect the rest. The ordinary school-course can acquaint pupils with no more than a beginning in any one branch of knowledge. The course must, therefore, be made up of the few really important sciences needed in daily life. Children must be taught to use language, spoken and written, the relations of numbers, and at least a general idea of the world about them. When these subjects have been put into the school-course, there is little room for what may be classed as “general knowledge.”

Consequently, it will be found that many children are very ignorant about the commonest things of their daily life. They can not tell anything about the origin

of the food upon their tables, the clothing upon their backs, the wood that forms the furniture around them, or, in short, about the very means of life upon which they are entirely dependent. To the ordinary city child, shoes are not traced beyond the shoe-store; clothing begins in the drygoods house; meat has its origin at the butcher-shop, and coffee at the grocer's.

Now, all this represents a complete change of view from that of the uncivilized man. The child of the African savage, the American Indian, the South Sea Islander, or the Eskimo, lives close to nature. He knows whence come all those things that feed him, clothe him, and protect him from the weather. He knows them as realities, and as bits of nature. The civilized child knows these things only at second, third, or even twentieth hand, and has lost, for the most part, all realization that the table in the room was once part of a forest tree; that his rubber shoes are the product of a gum that oozes from a plant on the banks of the Amazon; that the ivory paper-cutter was once part of the tooth of an elephant.

It is these facts which this book is meant to bring out. It will answer the questions a curious child should ask concerning the animal or plant products upon which his life depends.

Besides answering these questions, the volume has a further and more important purpose. By causing the young reader to recognize the dependence of himself and his race, from the beginning, upon what plants and animals have furnished, it is hoped that he will, as never before, understand that they must be cared for and treasured. Civilized man has been wickedly wasteful. There is barely time enough to avoid the

great evils now threatened, if this wicked waste can not be stopped. We must save our forests; we must protect our animals; we must treasure our plants; we must learn how closely all animals and plants are related to one another, and dependent upon one another for their existence, their preservation, their increase, and their improvement.

If young people can be taught early to see these things, they will grow up into men and women willing and eager to work for the increase of the earth's treasures. They will stop the slaughter of animals, the destruction especially of birds, the willful neglect of forests, the stupid misuse of crops—all the short-sighted and ignorant waste of what has been granted us for our support, our comfort, and our improvement.

The editor wishes to thank his contributors for their coöperation in the preparation of this volume.

TUDOR JENKS.

PART I.

OUR DEPENDENCE UPON PLANTS AND ANIMALS.

CHAPTER I.

Our World and the Stories it Tells Us.



IN a very true sense it may be said that every one of us, old or young, rich or poor, owns the whole world. Of course, this does not mean that each owns it in every way in which anything can be owned. It does not mean that you, for example, can sell the world to another, or can forbid others to live upon it, or can direct what those who live on it shall do. But if you think the matter over carefully, you will find that very few owners have complete control over their property. Everyone must consider the rights of others in regard to what he owns, and must use it so as to benefit them, or, at least, so as not to harm them.

WHAT "OWNING" MEANS.

Take, for instance, a farmer who owns a farm in a village. Although he has the right to say a great deal about the management of his farm, and may even sell it to another, yet he has to consider not only the rights of his own family, and must so use his land as to provide for them, but he also is kept by many laws and customs from misusing his land or from allowing it to be a nuisance to his neighbors. Even more than this is required of him by the public. If it becomes

necessary for the general good to build needed roads or railroads, or make a public park or common, the law says that the man may be compelled to give up his farm, though he must be paid for it. This shows that to own a thing is not always, and not often, to have the right to have all the say about it.

RIGHTS OF THE NATION.

Let us take another case. Let us suppose that a nation goes to war, and finds a need for planting its cannon on a certain farm. Then the General, as you know, does not ask permission of the owner, since it is understood that the needs of the nation come first. In the same way, the owner of a city house is allowed to keep and use it, but is compelled to do many things for the benefit of his neighbors. His house may even be taken away from him, or destroyed, when that is necessary, as when houses are blown up by the firemen in the city in order to stop the spread of a great fire.

These few examples, and there might be many more, show that owning a thing does not always mean having the right to do as one pleases with it. But the way in which each of us may be said to own the world requires us to give another meaning to the word "own," namely, to have the right to use it for his good or his pleasure. This way of using the word has two sides to it, and how much it means will depend upon the person who makes use of the thing we are considering.

THE OWNER OF NIAGARA FALLS.

This may be illustrated by a little story which tells how an American woman traveling in England was asked whether she had ever seen the Niagara Falls. She replied to the question by saying, with a smile, "Seen them? Why, I *own* them!"—which was true, as the Falls are situated on property then owned by this woman or her family.

But while it was true that the law would say this woman owned the Falls at that time, you can see readily enough that, in another sense equally true, the Falls belong in a most important way to every one that can see them; for the value, or real worth, of this great natural wonder lies in the feeling that the sight of them gives the beholder, and this value can be taken and enjoyed by every sightseer without in any way taking from their value to every other looker-on. And if you think a little you will see that this value as a wonder, as a marvel, as a poetic beauty, is greater to one person than to another. To one mind the sight of the Falls might mean little or nothing, to another a single glance might leave an effect upon the mind that would last throughout life. And therefore it is perfectly fair to say that the second beholder, the one with the more poetic mind, is able to take more value from the Falls, and to find more value in them. It is in this sense of owning that every one of us may own the whole world. So far as we know, it was made largely to give comfort and pleasure and joy to mankind, and we have each of us been fitted to find great, or small, pleasure in it.

THE WORLD FULL OF BEAUTY.

There is no other reason that we can imagine why the world should have been so full of beauty. For example, we do not see any reason why the sky and clouds should give so much delight to the eye, except for man's pleasure. So far as we know, the practical effect upon the world would have been the same if the sky had always been a dull, monotonous gray, instead of changing from the blackness of the thunder-cloud to all the jewel-like richness of the most brilliant tropical sunset. Trees, with their beautiful forms, flowers, so exquisite in shape and hue, animals so full of grace, grandeur and quaintness—all seem, in part at least, to have been made for the delight of man in beauty. Even those who might

wish to deny this must admit what amounts to the same thing, that mankind has been so made as to take pleasure in nature.

STORY OF VON HUMBOLDT.

One of the greatest men of science in the last century, Baron von Humboldt, spent a number of years in traveling about the world, seeing its beauties and studying its wonders, and making record of them for our benefit. In the great book which he wrote on his return, he tells a striking story. You may understand it either as a fable or as a miracle, as you please, but it is told as a fact.

Humboldt says that while he was traveling in the depths of a South American wilderness, with no expectation of seeing any one except the savages, he was amazed to meet a single white man who had evidently been wandering amid these wastes for some years. This man was a priest. When the two had been some time together, Humboldt asked how it happened that a priest of the Church felt himself free to wander thus alone, apparently with no other object than his own pleasure.

In reply, the priest told Humboldt that, several years before, having been since his boyhood busy about the affairs of the Church in a small community, he had fallen sick, and indeed, as the priest expressed it, he had died; that then he had met some angel or other great being of the future world. This being had questioned him about his knowledge of the world he had left, and the poor priest had been compelled to confess that he knew little or nothing about it, having been busy for so many years with duties that kept him in one small place, without any chance to travel.

Thereupon the angel or spirit had reproved the priest, saying that this great world had been made beautiful and interesting that it might be enjoyed by mankind. The priest had then been instructed to go

back to the world he had left, that he might see something of its wonders and beauties before he passed on to another.

WHAT THE STORY TEACHES.

Humboldt certainly tells the story as if it were true. But whether true or not, the lesson it carries is one needed by the large part of mankind. We know that this world is full of things, meant, it seems, for our comfort, our pleasure and our delight, and we can certainly enjoy it if we fit ourselves to do so. There are few lives so confined, so narrow, so hard-working, as to prevent all study of the wonders and beauties of nature. It is hardly too much to say that there are none; for even prisoners in dungeons have found years of study and delight in the possession of a single plant, or even an insect. The great Darwin wrote a book that is marvelously interesting and quite as important as it is interesting, based upon the study of the earthworm alone, and found so much in the life of this one creature as to set other men to work in carrying on the many interesting studies he found connected with it.

NATURE'S MARVELS EVERYWHERE.

It is not even necessary that one should step outside of his own home in order to find subjects of study that will help one to love nature, to wonder at its marvels, to delight in its beauties. Everything we use in the household, of course, comes from the outside world. The books we read, the clothing we wear, the food we eat, every tool, every picture, the carpets, the ornaments, the dyes that give color, lead by a short path to some truth of nature, to something either plant or animal or mineral in the world outside.

Children themselves recognize this in their game of "Twenty Questions," when they put the first inquiry, whether the thing thought of be "animal, mineral, or vegetable."

WHAT WE FORGET.

But we of today have become used to seeing things so long after they have come from the outside world that we forget who really gives them to us. We see the leather-bound book without thought of the sheep or goat whose skin makes its cover; we see the scarlet cloth without remembering that were it not for the death of many curious little bugs the gay, bright color would be but a dull gray; we sit before the polished table forgetful of the wonderful mahogany tree from the tropics that gives us the broad planks from which it is made; and we notice its polished surface without a thought of the seeds that have been crushed to give the rich oil that makes the table so glossy.

Long years ago, when both old and young were forced to make all things for themselves, they knew more of the animals or plants they must have for the many useful things making their homes comfortable. In truth, they had to know. We do not have to know, but we shall take more pleasure in the things about us if we can tell how they are made, and can know something of the long chain of work, of effort, of danger perhaps, that connects the comforts of our homes with the world of nature outside.

WHAT THIS VOLUME TELLS YOU.

In this volume we are going to read only about those things that come under the heading "animal" or "vegetable." In short, we deal with the living things, and what they mean to us in supplying our needs and our comforts—not including the mineral world.

We wish you to know, for example, when you pick up your knife at the breakfast-table and look upon its white handle, whether that handle represents one of three stories, or more. As you know, the finest handles are made from ivory, and these now cost a great deal. A cheaper sort are made of bone, and others may be

of celluloid or of what is known as "composition." Each has a story to tell, if it could speak. The ivory handle could tell a story either of the jungles of Africa, of cruel slave-hunters, of suffering slaves driven by whips, of treasures of African kings, or, possibly, of the hunting by white hunters of great herds of elephants, or even of the digging up of the monsters that lived before history in the frozen regions of the North; or, possibly, for the ivory may have come from the Arctic regions, we might be asked to listen to the strange story of Eskimo life, of the hunter in his little skin-boat, or creeping over the hummocks nearer and nearer to the great walrus, as it lies upon the edge of the floe, ready to slip into the sea.

The bone handle could tell us of modern business, of the raising of cattle on vast ranges, of the great packing-houses where thousands of cattle are disposed of daily, to be sent flying to all points of our great nation in heavily laden cars. The celluloid handle could tell a story of modern magic, of the making of a soft, fleecy cotton-fiber and the juice of another plant (the camphor-tree) into the strange substance that has, by replacing ivory, put two little plants raised by farmers to do the work that formerly involved so much suffering and adventure. And the common, cheap "composition" handle might have a romantic story to tell, the story of some inventor to whom study and effort brought success and comfort.

If such stories are, and they surely are, connected with the first household article one picks up, it is certain that a little study, a little reading about these things of our daily life, will make the world more interesting to us, and will teach us much, helping us to know not only the lives of our fellowmen, but of the animals and plants upon which we are all dependent. And everywhere, as we read of these things, we shall find wonders and marvels, and we shall learn of new beauties in the world around us.

CHAPTER II.

Earliest Forms of Life.

NO one knows how long the world has been the home of animal life. We only know it must have been millions of years since the earliest living things were here.

LIFE IN ANCIENT TIMES.

It is not at all necessary that we should know fully the story of life on the earth—a story that goes back so far as the first sign of life. No one knows how many thousands of years passed before there were creatures at all like ourselves on the whole earth.

Of this time we could know nothing, were it not that as plants and animals have died, the harder parts of them have either been kept for us by being surrounded by stuff that changed into hardened sand or into rock; or, if the parts of the animals themselves were slowly taken away, they left their prints fixed in the soil or the rock around them; or else in the place of the parts that had been removed, hard substances have been brought and left in the shape of the old living creatures.

FOSSILS.

It was many years even after these rock-markings, or fossils, were first discovered before man decided what they were; for we can not too often remember that the careful, thoughtful knowledge which we now know by the word science, was for untold ages entirely absent. Even after wise men had learned to make shrewd guesses, or to come to right conclusions, these men had no public among whom to spread the knowledge they gained. Here and there some lover of

knowledge whose name has come down to us, sometimes as that of a wonder-worker or magician, or later as a philosopher, had clear views concerning much of the world and its creatures.

But it was only one man in a hundred thousand that knew anything about the real facts of the world, of the skies, of plants, of animals, or his own race.

How long men have been on the earth no one knows, but it certainly covers a period of hundreds of thousands of years, and the earlier part of that time saw man, it is believed, only as a superior sort of animal. From the earliest traces of man's life on earth we can form some idea of what mankind was like further back, but we know nothing about a time when man had not learned to use something that might roughly be called a tool, even if it was no more than a stone he could grasp and use in hammering—perhaps to break the shells of nuts or of shellfish; or the horn of a deer which he could use as a weapon or a pick. It is thought that even these earliest men were far less hairy than any of the animals, and therefore needed protection from the weather, which they found by using the skins of beasts or the bark, foliage or other parts of plants, even as savages do to this day.

Thus, as far back as we can find out anything about our own kind, we find man largely dependent upon animals and plants, not only for food, but for clothing and tools and weapons.

WHEN LIFE BEGAN.

But, back of all this, we must think of a time when life on the earth was just beginning. The men who have studied these periods most deeply do not entirely agree in all respects, but there are certain views which are taken by them all. It is very generally thought that the earliest life began when there was little or no land, and that the earliest living creatures

were in the sea that covered almost the entire globe. Whether plant-life or animal-life came first is not settled, but as things seem to come first in their simpler forms, and then to grow more complicated, it is thought that the earliest life was a small, jelly-like substance that yet had within it a part more important than the rest. We still know of small living particles of this kind, and we know of nothing simpler. From these small bits of life are built up other forms, just as a wall is made up of separate bricks. The single bit of life is known by the name of "cell," and all parts of animals and plants are still made up of separate cells into which they can be separated. You can read the interesting story of cell structure in Chapter VI of the volume on Physical Life.

All this has been learned by starting with the forms of life today, and going gradually back to simpler and simpler forms, until we reach the single cell. This gives us a sort of chain of life both in plants and in animals, and we consider this chain as extending from early to later times, with its links of separate forms of plants or of animals gradually growing more and more complicated and more and more like those we know today.

THE CHAINS OF LIFE.

It would be better to say that there are uncounted numbers of these chains, leading from the simplest forms to the most complicated, or highest. Some of these chains of life lack but few links, and of others we have only a few pieces, with wide gaps between even the few links we have. Some begin as far back as we can trace any life, and then abruptly stop, after long ages of existence. Others come all the way down to our own time, and by their gradual changes show that every part of the chain belongs to the same great connected line.

You will find in books that tell the past history of

the earth plans or maps drawn to show how these lines of life extend from old times to the present; how they are broken, how they are lost for a time, and then continued, and how some lines of life are closely related to certain others.

By comparing one chain with another, by seeing how one plant gradually changes its form step by step, and how one animal goes through very similar sorts of changes, it is impossible not to see that for the most part all these lines of life have gone according to a certain great law. This law is what is meant by Evolution, which means the gradual change from a simple plan to one more complicated, and so on, often to a plan that is more complicated than we can yet fully understand.

THE SIMPLEST ANIMALS.

The earliest forms of life have power to do but a very few things. Thus the little single-cell animal can do practically only two things: it can change the shape of its own body, and can take particles into that body. By means of this first power, it can move about; by means of the second, it can feed itself. A little later in the history of life we find that the cell-like animal can split up into two, and thus become its own children. If a man were able simply to move from one place to another, to eat, and then to divide himself into two creatures of the same kind, he would have the same powers as this little cell. Yet from that cell-like animal to the man of today, we shall find growing by gradual changes a very great part of the links that make up a complete chain of life from one to the other.

Of these earliest forms of life, the little cell-like creatures, there certainly must have existed an innumerable host, too great to be understood in figures. Whether they all started from one cell, we need not decide, but we know that each one of such creatures can double itself so rapidly that even a single cell

would soon have produced untold billions. Thus began the lives of these beings, and with their lives came changes. The changes gradually produced, as we have said, more complicated creatures, and these gave rise to others, until the world swarmed with life, as it does today.

LIFE EVERYWHERE.

There is no way by which one can get a better notion of how the whole of our globe teems with life than by examining, with a magnifying-glass, where necessary, a small portion of the earth during the season when life is active. Even out of a few square feet of turf one may get enough material for months of study. The sea, the earth, the air, plants, even animals themselves, all are the dwelling-places of creatures, known and unknown, the very species of which are numbered by the thousands, and by hundreds of thousands when we come to insects.

One's first thought would be that to know anything about these creatures is impossible, that it is useless to study a few, when thousands must be left unseen. And this would be true, except that the world and universe are made according to a plan. This plan can be learned, and unknown things can be understood by their place in it. Without a plan, we could neither learn nor teach.

To illustrate this, a savage who did not know how to read, and who should be made to understand the thousands of words in a dictionary might well think no one could ever find a wanted word. Yet we know that a very young child can, in a few moments, turn to any word whose spelling is known, because all the words are put *in a regular order* that can be understood by any one who knows the alphabet.

WHAT "SCIENCE" IS.

Now, in the same way it has been found that all living things can be put into order, and that for the

most part this order is not hard to understand, if we seek to know only the general facts. Take any insect, known or unknown, and carry it to a man who has made a study of these creatures, and at the first glance he will be able to tell you much about the creature and its life, even if he has never seen it before. He knows where it belongs in the big "dictionary of science." Likewise the man who knows plants—the botanist—even if a plant is unknown when he finds it, can yet place it with its relatives, among its "cousins," as it were, and may even be able to tell us much about its character and its life, because he knows that plants of the same family agree in character and habits, as do related people.

Let us go on for a moment with our illustration of the dictionary. The first books about words were very short and simple, often written by one man, and contained little knowledge. Today the big dictionaries are made by putting together all that was learned before them in making other dictionaries. Each is the work of hundreds of men, even thousands, if all who took part be counted, and they contain an amount of knowledge that is simply amazing. It may be said that any of our bigger dictionaries of standing knows more than a thousand men.

Now to return to the question of science. It is only within a few years that there has been enough knowledge of nature, to make up books that compare at all with our modern dictionaries. The early books on science, like early dictionaries, often recorded what was known by a few learned men; but they were very imperfect, and, of course, contained many errors. When printing became cheap, when men learned to work together, the making of our modern books of science became possible. Not only was much true knowledge gained, but many old errors were found out and corrected, and so true science began.

CHAPTER III.

Coming of Animals to Modern Forms.

HOW SCIENCE MEANS WORKING TOGETHER.

NE of the most important things that have come about from putting knowledge into order, is the working together of men all over the world to make the story of animals and plants every day more complete. Not only is all which each learns told to the rest, but there is a dividing up of the work so that not too many shall work at one part of science at a time. Whatever is learned goes upon record in printed form in books, bound or unbound, and these are sent throughout the world where other workers than the first discoverers can learn from them facts that are helpful, and can sometimes find the key to puzzles over which they are busied.

In this way the great story has every day become more complete, though it is so vast that there is no danger of using up the material or of learning the whole story. In this great story there are two great volumes; one contains facts about the past, the other facts about the present, and guesses or reasons looking to the future.

THE BOOK OF THE PAST.

From the book of the past we have already learned enough to understand something of the magical changes connecting the plants and the animals of to-day with the earliest beginnings. Although the complete story of the life of a single kind of animal is never likely to be told in every detail, yet they are somewhat alike and show an agreement in their laws that helps us to fill up parts entirely missing.

To take one of the animals we know best, the horse, as an example, we can make a fairly full story of the horse family from the very earliest times down to the present; and even where some facts have not yet been found, we find changes leading to them and leading from them that leave no doubt that the horses of today are related to the earliest of their kind—the little five-toed animal that more nearly resembles a small, slender dog than what we are accustomed to think of as “a horse.” The story of the change of this animal is fairly well known, and our museums contain pictures, images, and casts that show how the five-toed creature gradually lost all but one toe, developed its handsome mane and tail, increased in size, weight, and strength, and thus became fitted for use in riding, driving, and the pulling of heavy loads. The elephant also can be traced backward and forward along its family line until we have a fairly complete story of its growth from a small animal with a long upper lip into the great creature, with its truly marvelous trunk, that is found today in Africa and in India.

BIRDS FROM REPTILES.

When we come to consider the bird, we shall be told of a much more marvelous change that has made the exquisite flying creature from an animal so unlike it as the scaly, crawling lizard. Other animals, instead of growing in size and becoming more powerful, cleverer, and more beautiful, have done the opposite. There was a time when the beaver, or a creature like it except in size, was truly an enormous giant, compared to the present form. We shall find also, by looking into this book of the past, that some animals seem to have turned back on what we think is the path of improvement, and have become like their own ancestors of ages upon ages before. In brief, the stories in the book of the past seem, like

many romances, to have sometimes a happy, and sometimes an unhappy, ending; for animals become what we would call better fitted for a higher life, or become less fitted to it, for reasons that we can sometimes understand and explain, but that quite as often are still puzzles we can not solve.

WHY SOME ANIMALS HAVE SUCCEEDED IN LIFE.

But we have learned from the study of this book at least the fact that the creatures we see upon the earth today have kept alive because they have become more and more able to earn their living, to escape their enemies, to find places fitted to them, or to fit themselves to the changing conditions around them. Some of the creatures we know are little changed from the oldest forms about which the book of the past gives us, here and there, some facts. Many fishes, insects, reptiles, seem to have lived in forms not greatly changed through the countless ages during which other animals were so completely modified. This leads men of science to think that the forms now existing are only a very small part of those varieties that have been found, at one time or another, upon the earth. Nature has made, as they put it, thousands and thousands of experiments, indeed a countless number, and out of all these a few have been what we may call successful, and have brought about such a form of plant or animal as can exist and keep its race alive.

MAN AS AN ANIMAL.

Since man himself as the scientific student looks upon him must be thought of as an animal too, and in every part of his body shows traces of having been through the changes that have affected other animals, until he succeeded in going beyond them, we have his story also in this book of the past, though unfortunately it is a most incomplete one. We can

hardly fail to believe that our own kind differed little, so far as body is concerned, from not only the higher apes, but from many a lower animal whose long line of ancestry shows that it was for some time traveling in the same direction that brought about the existence, not only of the apes and monkeys, but of man himself. It is only a few years ago, less than a century, that even scientific men were led to this belief; but ever since it first began to be whispered, there has been a stronger and stronger proof of its truth, and it is not too much to say that no well-educated modern naturalist would think of denying it.

There have been many attempts to describe, or picture, just what sort of an animal form could fairly be called earliest man, but even the young reader will understand that there could be no such thing as a point in the long line at which one can say, "Here the animal form gives place to human form." While it is true that some species seem to make their appearance in this great book of the past without the gradual beginning that we know must have been gone through with before the more perfect form could exist, yet the lacking links in the chain may at any time be found, as other missing links in the great chains of animal and vegetable life are daily coming to light turned up by what has been called "the greatest archæologist—the spade."

THE EARLIEST MEN.

But if we can not choose just the point at which man began, we can go back easily to a time when men differed from animals mainly in the fact that they could use some sort of tools or weapons, and that they knew at least how to preserve fire, to keep fire going—a thing which no animal has ever learned. Naturalists tell us that monkeys will warm themselves by the fires travelers leave burning, but no animal has ever been seen to add fuel to a fire to keep it alive.

It is true that the tools and weapons spoken of were at first the rudest possible bits of stick, lumps of stone, horns, or twisted grasses. We see by the remains of fires, ashes, scorched bones, where these early men made their homes. We find such remains in caves or near bodies of water, lakes, or rivers.

THE FIRST ART.

And, most remarkable of all, we can hardly go back to a time when there was not at least the scratched drawing upon a bit of stone, or the scrawl upon the wall of a cave, that proves at once there was something in these animal-like men utterly beyond the keenest intelligence of the highest animals we know. Whatever these early men may have been, they *thought*, and they *drew pictures*. If their drawings were mere rude lines, such as the youngest child might scrawl, it would be a most wonderful fact, but they were far more. They show not only the wish to make pictures, but they are so well drawn as to prove a far higher intelligence than is today possessed by many savages who have advanced greatly in arts of living, but are not artistic.

WHAT THESE DRAWINGS SHOW.

Besides showing intelligence, these drawings, which represent deer, the mammoth (the hairy elephant that long ago ceased to exist), and the horse, prove how very important to these savage men were the animals about them. Even at this early time, we may be sure that mankind were already using wood for fuel, and making clothing from skins and furs of animals. Without the warmth of fire, the shelter of caves or of trees and bushes, the weapons of wood, possibly hardened by burning and pointed by grinding upon stone, without the spirit that made them willing to work for one another, it is impossible that men should have lived through the long ages when

fierce flesh-eating animals abounded throughout the earth, ready to devour the feeble animals that men were. For we must not forget that, as a mere animal, man was less protected, less armed, less powerful, and less swift, than most of his enemies. He could not have had sharp claws to be compared for a moment with any of those of the great beasts he feared; he had no thick armor of hair or of fur, no horns or powerful fangs to be opposed to those of beasts with whom he must fight for his place on earth. There are signs that he may at one time in the distant past have had the large canine teeth, and perhaps the strong nails, possessed by some apes, but he certainly was not long in finding out that a deer-horn held in his hand and used as a weapon was far more dangerous to his enemies than either tooth or claw. He must have been somewhat covered with hair, but his brain soon led him to prefer covering taken from other animals, and then his hairiness became less as it became unnecessary.

MAN WAS MASTER OF THE OTHER ANIMALS.

In short, the history of early man, as told in the book of the past, shows us beyond doubt an animal, but an animal with a brain that sought comfort and the means of life at the expense of other beings, and thus gradually ceased to need the true animal body with its self-contained weapons, protection and independence.

We see all other animals succeeding in life by changes in themselves. Whatever they acquire is wholly *within* and attached to their own being. We see man choosing another line of progress. From the earliest form in which we can give him the name "man," we see a creature learning to use the world about him, and storing up power in his *brain*, rather than fitness in his animal body.

The story of mankind, therefore, begins as soon

as we find men using outside nature, and the story of his progress is best told by showing how he turns to his own uses the world around him. Out of this use of the brain there grows another life to which we can set no bounds—the world of sentiments, of beliefs, of hopes and fears, that go far beyond the question of man's well-being or even of his happiness.

WHY MAN BECAME A BRAIN-WORKER.

Men were always clever animals, and we cannot tell why it is that there were no other creatures to develop as man did. Men were weak, unprotected, without natural weapons, and they learned to combine, to work or fight together, to make weapons, to outwit all other creatures. Why did not other weak creatures do the same? We do not know.

CHAPTER IV.

Life of the Earliest Men.

IN Chapter III, we read of man as one of the animals, then as becoming much higher than any animal, as making for himself tools, weapons, clothing, and even as an artist who drew upon ivory the forms of the living creatures around him. If we knew only of such drawings, we could say that man when he made them had become something much more than an animal.

MAN IN THE AGE OF COLD.

The clever drawing of the great woolly mammoth is also most interesting as a certain proof that the man who drew it must have lived at the same time as this creature who is so evidently adapted for extreme cold. From this we may conclude that this same man and his fellows must have known how to keep themselves warm by the use of fire, and by clothing made of the skins of beasts. It is also known that the regions in which the mammoth was found were at the same time the living-place of the woolly rhinoceros and great flesh-eating "lions" or "tigers" (to use names that do not exactly apply) also of a giant ox, of the reindeer, and the musk-ox, the latter not very different from those now found in the Arctic regions.

HIS TOOLS AND WEAPONS.

The rudest stone tools or weapons of that time are found to be of two general kinds; those that are pointed, and fitted for the making of holes, and those that have one or more sharp edges for scraping and cutting. Some ages afterward, if not at that time, we find slender lance-points, and, what is more wonderful,

the clever invention of harpoons or spears with barbs fitted to hold animals they pierced. They are called harpoons because some of the bones we find in the fire-heaps plainly show that the long stringy sinews have been cut off, which makes us think that these cords were attached to the barbed spears, fitting them for use in capturing animals in the sea.

HOW HE LIVED.

Men of this time were rude hunters, and had not yet learned either to raise crops or to keep domestic animals. We find neither dog nor sheep bones. Just what groups these men lived in we do not know, but some sort of a "family" or tribe must have existed, since the fire-heaps show that a number lived together. Outdoors, they spent their time in hunting and fighting; indoors, in making their skin clothing and their bone or stone tools. In the worst weather, no doubt they remained in their caves, as Eskimos of the far North keep within their snow huts. They could not have been very nice in their habits, since their homes are full of the waste part of their food.

There is just one sign of what we might call a manufacture or a business, for in a cave, in France, are found a very great number of one kind of sharp flint knife, or arrow-point—a proof that this group of men made more of this weapon than they needed for their own use, and must have exchanged these for other things. Another cave likewise shows an unusual number of bone tools. This sort of life existed in many widely separated parts of the globe. We can not tell how long it lasted, but there is no doubt that little improvement took place for many, many centuries.

MEN OF THE LATER STONE AGE.

What is known as a second Stone Age followed. Improvement was gradual, but we at length come to a time when men seemed to depend more and more upon

shellfish. They have left great mounds of the shells, five or ten feet high, a thousand feet long, and one or two feet broad. Mixed with these shells are bones of birds and larger animals, showing that these also were eaten, though not so commonly.

The makers of these mounds were catchers of small fish and gatherers of shellfish upon the shore. Now and then are found the remains of deep-sea fishes, but it is doubtful whether we can judge from this that these men were able to go out upon the sea. It would seem that these might have been caught by the tides, or thrown up upon the shore, for we know this sometimes happens.

There is, however, a proof that we can not dispute, for canoes have been found, trunks of trees roughly hollowed out, but not pointed or rounded, though now and then the under part of a bow seems to have been cut away. These boats were made probably as Robinson Crusoe made his—by burning out the hollowed part, and then finishing with the stone tools. If these men had fish-lines, they were of twisted bark or woven grass.

A CHANGE OF CLIMATE.

The animal remains found in these heaps are no longer those of the Arctic regions; the climate must have changed to a milder one. The animals of the colder climates had gone north, as did the reindeer, or to the cold upper levels among the mountains, as did the chamois. There are bones of a wild bull, of the seal, and of the beaver. Though we find no bones of tamed animals, some bones are gnawed, and there is the absence of just those bird-bones and softer bones which dogs would eat. It is therefore thought that in this second Stone Age the friendship of man and dog began.

It may be asked why we find these two states of living so different from one another, instead of finding

that the earlier, by slow changes, turned into the later. It is hard to explain this, but some wise men think that the tribes who lived in a ruder way were driven from those parts of Europe in which they had lived so long by the coming there of another set of tribes who had elsewhere learned to make the better tools and weapons, and who depended upon the shore products for their main support. This would at once make the complete change we see.

These remains of a bygone way of life show us that the whole state of men's living depended upon the sort of animals that gave them food, and the ways to gain food from the woods or from the sea.

THE FIGHT FOR LIFE.

In the early days, before men were civilized, there were only certain parts of the earth in which they could live in any comfort. Where the climate was too hot, too cold, or too dry, their life was a long struggle, and there could be little thought or time given to anything but the getting of food, the providing of shelter and clothing. The frozen regions of the North still show us the sort of life that men must lead under the hardest conditions, for the Eskimos, though they have shown that they have clever minds and much ability, since they are artistic and ingenious, yet have had no chance to improve in the way of living led by their race from the most ancient times.

We may say much the same of the dwellers in the desert. Though they, by means of the camel, can wander from one water-hole, or oasis—the green spot that springs up wherever a little water can be had—yet there is no improvement from one age to another, the wandering Arab of today having made no advance over his ancestor of ages ago, unless it be in the possession of firearms, for which he is indebted to other races than his own.

Even on the ocean, after ships had become able to make long voyages, men could not be well provided

for, owing to the need of carrying fresh water for drinking and for preserving food; it is hardly more than a century or two ago that the terrible disease known as scurvy, which was due to the want of vegetable food, made long voyages merely times of great suffering and fortitude.

HOW MAN HAS WON IT.

Civilized men, however, can provide for themselves everywhere, taking with them in easily portable form all they need to supply their wants and to insure their comfort. A small sledge or two can carry enough provisions and supplies to support several men for a long period, as was recently done in the last stages of Peary's journey to and from the Pole.

The life of the earliest man about whom we know anything is much like that of a castaway sailor upon a desert island. Indeed, such a sailor has to win his living just as did the earliest tribes, and mankind may be thought of in the most distant ages of the past as resembling a little band of naked castaways upon that great island, the earth, as it floats in space. But each generation has not only had the use of all that earth produces, but has been able to hand down to its children and successors a million contrivances helping to make life easy, as you will clearly see in Volume X on the great inventions and discoveries.

A STORY TOO BIG FOR TELLING.

We can to some extent tell briefly how the earliest men lived, but as soon as we pass on to later times, to the time when men had learned to use metals, beginning with copper and bronze, and going on to iron, steel, and the innumerable compounds and mixtures chemists know today, the story becomes one it is impossible to tell. We can only give a bit of it here and there, trusting the young reader to learn from these hints the meaning of all he sees about him.

In order that any one of us should lead what is known as the civilized form of life, we must depend upon the work of millions of our fellowmen in all parts of the world, all of whom are getting and making ready for our use the same nature-products that each man once had to find or prepare for himself.

THE BRAIN-WORKERS.

While we remember all these who are working for our comfort while we work for theirs, we must think also of those who are busy with brain and pen, the thinkers, the writers, the inventors who tell other men how work is done and help them in that way.

These men must learn to teach the rest.

CHAPTER V.

Too Little Knowledge, and Too Much.

S men when they were only ignorant savages used rude tools and weapons, blocks of stone or branches, and from these learned how to make others that were better, so the brain-workers and thinkers among men at first knew little, and could not think to good purpose. When they saw some new plant or animal, they tried to find out facts about it.

MAKING GUESSES.

Knowing little, they saw much they could not understand, and could not explain. The only thing to do was to make guesses about these new things, and then see if they had guessed wrong or right. For many thousands of years this guessing kept on; it was the beginning of science. As men became wiser, they came to know many facts, and these were handed down from parents to children. But until within a few hundred years, there was no sure way of telling facts from errors, and thus many absurd notions were handed down together with much truth.

Indeed, long after men were highly civilized, and learned to live in a state of comfort and even elegance, they were as ignorant as savages of many things that we think every child should now be ashamed not to know.

OLD-TIME ERRORS.

In speaking of the scientific knowledge, or, rather, of the ignorance, that existed from the time of the Greeks and Romans even down to the settling of Plymouth in our own country and later, Edward Eggleston declares that everybody believed that many

insects, birds, and fishes came from decaying things. Thus, it was thought that from dead horses arose hornets, while dead cows gave rise to honey-bees. Wasps were formed when apples or pears rotted, minnows came from foam, and it was declared that the dropped tails of tadpoles changed into lizards. Francis Bacon, perhaps the wisest man of his time, and the best informed in science, believed that water, mixed with mud, decayed and produced toads.

ERRORS MADE INTO FABLES.

It was not enough that such guesses were made, they had to be improved so as to seem reasonable. Thus it was said that the leaders of the bees came from the brain of the dead cattle and common bees from the flesh. It was not very long before that such queer fables were seriously believed as that of the salamander who lived in flames, and of the cockatrice and basilisk whose glance was fatal, or of the duck-plant whose fruit dropped into the water and changed to ducks and swam away. And such absurd stories were generally thought sensible by the most intelligent people.

Nor was it the ignorant alone who told these stories. A noted botanist, Gerarde, in 1588, tells in his *History of Plants* how, out of certain plants "in time comes the shape and form of a bird hanging by the bill; in short space after, it comes into maturity and falls into the sea, where it gets feathers." The creature so produced was called the "barnacle-geese."

In the same way it was reported and gravely put down in many books of natural history that the swallows dropped into the water, were covered with mud, and so remained until they came to life again in the spring. This was to account for the disappearance of the birds after they had gone south. This story was still accepted as late as 1800.

NOTIONS AND SUPERSTITIONS.

Even in the profession of medicine there were such wild absurdities that we can scarcely credit them. There was a general notion that all things were so marked as to show what they were good for. Thus, the doctors would use a yellow powder, saffron, for the cure of jaundice, simply because the patient's face was yellow in that sickness. If a toad happened to have warty marks on its back, this was a sign that toads were meant to cure warts. A great physician declared that there was "harmony between the sun, gold, man, and wine," and that therefore gold must be a remedy for human maladies.

HOW ERRORS BROUGHT FEAR.

With such wild notions about animals, plants, and medicine went the fear of comets, the belief in floating and magnetic islands, in witchcraft, sorcery, and ten thousand other superstitions that have only been put aside within the last two centuries. The old method of getting together knowledge was to reason out what seemed logical and reasonable, rather than to see what *is*, and to make experiments to prove what will happen.

What one told, another believed, even if it were so absurd a story as that the swan sang a sweet song just before dying, or that the phenix burned itself to death and then rose from its own ashes, or that there existed unicorns, mermaids, and races of men carrying their heads under their arms and having an eye in the middle of their chests. It is only since the time of our great grandfathers that all this useless rubbish has been cast out and replaced by a mass of proved facts that may be tested and found to be true by any student for himself.

In the history of our own country it will be remembered that Ponce de Leon was led to visit the New World in the hope of discovering the fountain of youth. But it is useless to mention even the smallest part of

the hopeless and nonsensical absurdities that kept our forefathers from seeing the plainest truths of the world about them.

A WORLD OF WONDERS AND MONSTERS.

It is hard for us to understand the great change that has taken place in a lifetime to affect our view of nature. Nearly everybody, a century or so ago, lived in a world of mysteries. All nature was filled with things not understood, with questions that could not be answered, with queer happenings the cause of which could not be more than guessed at.

The merchant who traveled over the rough roads by day and night, the sailor whose ship plowed its way through little-known parts of the great oceans, the hunter in the woods, the philosopher in his study, did not expect to understand half of what he saw. When thunder-clouds covered the sky and lightning flashed, people who were reverent believed that they beheld a sign of the wrath of God. Those who were superstitious thought, as many ignorant savages do today, that the storm meant that great monsters were quarreling in the upper air. If strange lights appeared, as they often do over marshes, then the ignorant countryman feared he might be led astray by the will-of-the-wisp, or some pixy or hobgoblin. The sailors saw, in the St. Elmo's fire, the glowing lights that now and then rest upon the ends of masts or yard-arms, either a sign of warning or an assurance of safety, according to where the strange appearances showed themselves. Even the every-day illnesses were said to come from certain "humors" in the body, and this word really had little or no meaning, being used only to conceal ignorance of the real causes.

Briefly, only savages are now as ignorant as were most folks outside of great towns no longer ago than a time covered by the lives of three or four men. Thousands of savages who have not yet come into touch with white men are in this state of ignorance still.

OUR OWN VIEWS OF THE WORLD.

But, excepting these, there are few indeed who have not left such ignorance to their ancestors. In our own times the change may best be expressed by saying that even those who do not know the reasons for things have at least learned to look for a reason, and one that they can understand. They may not know just why lightning shoots from one cloud to another, but they know that there are men who understand these things and can show that laws are obeyed even by the lightning flash. If the "northern lights" are seen in the sky, although the men who understand it are few indeed, and although the cause of the aurora may not be yet entirely settled, we all are aware that there is some other cause than the will of an imagined spirit, or angry fire-god, or some other cause equally the result of mere guesswork or of a fearful superstition. The recent visit of Halley's comet, it is true, frightened a few people; but there was no widespread alarm among those who were able to read a clear explanation given of its nature and course.

THE DANGER OF OUR TIMES.

In the old days the danger was that ignorance would make people accept vain and imaginary notions. In our own time the danger is that when there is so much knowledge, and it is all so interesting and so wonderful we shall become so used to wonders as to lose the curiosity and interest through which men have advanced to knowledge, or, still worse, shall look without reverence and awe upon all the truly marvelous happenings that are none the less beyond our comprehension though we have learned that they obey laws.

THE SAVAGE AND NATURE.

In the case of the savage people, so close is the connection between their daily life and the natural world from which they get all their food, clothing, and mate-

rials, that it cannot be overlooked. They understand at once that if the Indian warrior is to wear moccasins, he must manage to shoot or trap the creature whose skin gives him the leather for his footwear. If the Indian woman is to make pemmican, she knows that it is compounded out of the venison or other meat, of fat, and perhaps of some grain, all of which are pounded on a stone with another rounded stone before it can be packed or tied up into a bag.

WHY WE FORGET NATURE.

But in our own case, the materials have to go through so many hands before coming to those who use them, and they are so changed in shape and appearance, that, ordinarily, we do not think whence they came, nor that they have required as much, or more, effort before they take on the right shape for use.

If, for example, we see a man and his wife start from a neighbor's house for a morning walk, dressed perhaps a little formally, as they would be on a Sunday morning, we do not often remember exactly the sources from which are derived the articles they are wearing. Yet quite a list of animals and plants is required in order to cover even the most ordinary things which we are accustomed to see worn or used by nearly every one.

AN EXAMPLE—A MAN'S DRESS.

Let us take the man on his way to church, for example, and suppose him to be wearing the usual dress of a man in England or America, or, we may say, in any of the civilized parts of Europe, for, nowadays, old-time costumes are disappearing, and most people follow some general way of dress. Supposing this man to be wearing a high silk hat, we shall have to head the list with the silkworm that supplies its glossy fabric, and we must not forget the black dye which has

changed its color, a dye that probably came from some plant. The framework of the hat is made of paper, composed of vegetable substance, and inside there is a leather band, perhaps of soft sheepskin. The greater part of the man's clothing is, of course, either wool or cotton, and here again we must allow for certain plant-juices that give color to the garments. Buttons of horn or bone we owe probably to sheep or cattle, and either the goat or dog provides leather for the gentleman's gloves.

We have not tried to make as long a list as possible, though the chances are that there will be a variety of fibers in the different cloths used in minor parts of the clothing, such as the necktie, tapes, bindings, thread, and so forth. In addition, this man may carry a stick, of bamboo, malacca, rattan, or any of a dozen other woods, imported or home-grown. And the chances are that ivory will be found, either in studs, the cane-handle, or, perhaps, ornamenting his penknife. His pocketbook may come from Morocco or from the frozen seas where seals are captured; and if he carry a cigar or cigarette-case, it may be that the lizard or snake will have given a part of its skin to make the little sliding case. His shoestrings may well be porpoise-hide. And all this list may be made up without imagining anything but what is perfectly likely.

A WOMAN'S DRESS.

Many of the substances, animal or vegetable, already named, will, of course, go to the making up of his wife's clothing also, so upon our list there will be cotton, linen, silk, woolen, and very possibly some of the rarer and more modern fibers which go to make fancy materials. If her comb or hairpins be of shell or celluloid, we shall have to add the tortoise to the creatures mentioned, and the camphor-plant, which gives its essence to be used in making celluloid. In the trimming of her hat we hope there are no other feathers

than those which can be spared by the ostrich or by some edible bird whose life would be sacrificed even if fashion did not use its plumage. But there is hardly a bird of bright plumage which might not have given a feather to her adornment. In the same way, any of the finer furs might be found as a bit of hat trimming. Other materials that should be added are whalebone, from the mouth of some monster of the deep, rubber, hard or soft—the juice of a South American plant—and we must not forget that shells often give brightness or a touch of color to buttons or trimmings.

We have no wish to mention any rarity, only to suggest how many animals or plants are necessarily called upon to provide even the everyday costume of men and women who do not seek to be singular or striking. We have seen that, even apart from dyes and colorings, there are representatives of shellfish, of insects, of reptiles, birds, and the larger animals; that the plants are equally called upon, and that it would require many a long and toilsome journey if any one of us had to visit each of the places from which were brought bits of our clothing.

ANIMALS AND PLANTS, AND FURNISHINGS.

As we enter the house and glance about on floors and walls, and at the furniture, we can call to mind other long lists of animals and plants from whom we have taken our comforts, and this is much more forcibly true as soon as we sit down to the table, for in order to supply even what stands upon the ordinary dinner-table in the course of the meal, it is not too much to say that the whole world has been ransacked, and that merchants, sailors, shopkeepers, to the number of untold thousands, have been at work for months or years.

AT THE TABLE.

It is no easy matter to make all this plain, but it is no more than any one can do for himself. Coffee,

salt, pepper, seasonings, nuts, raisins, olives—we all know how many a long mile these have traveled before arriving at our table. Nor is it necessary that we should bear their sources or their long journey in mind, except when trying to learn how dependent we are upon plants and animals for every comfort. And we should also at least once become acquainted with the story of the commoner products, in order that we may know something of what our life means and how others work to supply our needs.

VALUE OF THIS KNOWLEDGE.

It is by learning these things from the beginning, by thinking about them, and by trying to make better use of the things about us, that men have risen from a living little better than that of the lowest savages to the comforts and luxuries of our great cities. If such comforts led to nothing better than themselves, they would be worse than useless, but when the mere necessities of living are more easily come by, men can give some of their time to what they think better worth their effort. They have hours to give to the arts, to music, to literature, and to all that makes men different from the other creatures upon the earth.

PART II.

PLANTS THAT MEAN MOST TO US.

Section 1—Food from Plants.

CHAPTER VI.

The World's Wonderful Fruits.

 FRUITS and nuts suggest things especially good to eat, things for dessert, for preserves and salads, and things we can eat *between meals* or out-of-doors. Perhaps we have been in the apple orchard and climbed to get a particularly large red apple, or out in the strawberry patch, on our knees searching under the leaves for the ripest and best berries. We may remember cool autumn days and nutting experiences when we bombarded some giant chestnut tree with clubs hurled where the burs appeared thickest and were rewarded with a pattering of the nuts in the dry leaves underfoot. How cautiously we pried open the burs, if Jack Frost had not already done so. One can think of many pleasant things connected with fruits and nuts.

WHAT ARE FRUITS AND NUTS?

But just what are fruits and what are nuts? Did you ever ask yourself the question? We do not want a technical botanical answer to the question, but just an ordinary everyday answer. So we won't ask the botanist to tell us, but will just take the ordinary definitions of fruits and nuts as things that are good to eat.

To begin with, fruits and nuts are alike in that both

are products of flowers. Whenever you are eating a fruit or a nut, you may know that there was a flower before it. Of course every one has heard of apple blossoms, cherry blossoms, and orange blossoms, and probably most of us know that the fruits of these trees mentioned have come about by the ripening of a part of the flower. But nuts come from flowers in much the same way. The walnut and chestnut have flowers just as the orange trees; but the flowers of nut trees are usually not very striking either for beauty or for fragrance.

How then are fruits and nuts different? If you want to know just how a fruit usually differs from a nut, some time take the pit or seed from a peach and compare it with that nut we all like, the almond. You will see that they look very much alike. Break open the peach pit, and you will find within a meat or kernel like the almond meat in shape, and almost exactly like bitter almonds in taste. The fact is the almond is a seed like the peach pit, and as it grew it had an outside covering something like the peach pulp, and so was a kind of fruit.

Fruits in general are soft and pulpy outside, that being the part we eat. Inside are one or more seeds which we do not eat. Nuts are just the reverse. The outside is always hard and inedible, the inside is the part we eat. Nuts as we see them are almost all just seeds. In this chapter we will tell you about the fruits and in the next chapter about the nuts.

WHERE DO FRUITS COME FROM?

Fruits, we have decided, are usually soft, pulpy flower products containing one or more seeds. The next question is naturally, "Where do fruits come from?" Of course we know that very many of the commonest kinds grow all around us, like apples, cherries, berries, and many others. Berries, by the way, you will see are usually small, clustered fruits

with often many seeds in them. Berries usually grow on bushes. Most of the larger fruits grow on trees, but the grape grows on a vine and the strawberry on a little low herb.

If we want to see the orange and lemon growing, we must go to Florida or California, or we may go still farther south to the West Indies, and see at the same time the banana and many other tropical fruits. If we want to see where most of our olives come from, we must go to Italy and the other European countries along the Mediterranean. To pick fresh dates in quantity, we must go to far-away Arabia, or to northern Africa.

Then there are rarer tropical fruits which may be purchased in some of the northern markets, like the mango, the alligator pear, the prickly pear, the pomegranate, and a number of others. It is interesting to learn from those who have traveled much in the tropics that the very best fruits that grow are those we know so well in the North. The banana is almost the only tropical fruit that is widely used in temperate regions.

There are many kinds of wild fruits and these are often very important food products in the regions where they grow, especially in tropical lands where all or nearly all the food supply may come from wild fruits. The banana is wild in parts of Africa, and is used there as we use bread and potatoes. There are so many kinds of wild tropical fruits that it would be impossible to tell even a little about each of them in the limits of a whole book. There are not as many wild fruits in temperate regions, but yet there are enough so that in the times before there were many cultivated fruits to be had they were an important source of food. Some of our common market fruits, like blueberries and huckleberries, are now from wild plants.

One of the most useful tropical plants is the breadfruit tree, but the breadfruit is hardly a "fruit" in the same sense as the apple or peach. It is always cooked

before eating and is used to make a number of dishes which serve the natives in the tropics instead of our ordinary staple foods such as bread, meat, and potatoes.

THE DIFFERENCE BETWEEN FRUITS AND VEGETABLES.

Perhaps some one may ask now, "What is the difference between fruits and vegetables, anyway?" It is not always easy to draw a line between them. Perhaps the best test is found in the way we eat them; if usually raw or in preserves, they are fruits; but if usually cooked, because they are not wholesome or good-tasting raw, then they are vegetables. So it may happen that some things may be fruits one time, and vegetables another.

WHAT ARE FRUITS MADE OF?

If we were to take almost any fruit and weigh it fresh and then dry it for a very long time or in hot air until it should feel perfectly dry, and weigh it again, we should find that the dried fruit had lost about three-quarters of its original weight. That means that the largest part of any fresh fruit is just plain water; and it is because of the water in them that juicy fruit tastes so good when one is thirsty. The water, of course, makes up the juice of a fruit, but the juice is always tasty, not like clear water, and the taste is due to a number of things which are in the juice, differing in different plants.

First of all is sugar. Some fruits have as much as a quarter of their weight in sugar. The kind of sugar found in fruits is an important food, and more digestible than ordinary granulated sugar made from the sugar-cane. All fruits have some sugar in them, and usually a good deal of it, even the sour-tasting kinds.

The sour tastes in fruits are due to acids, and different fruits have various kinds. All fruits probably

have some acid in them, but some (such as the lemon) have so much that only a sour taste is given. The acid helps digestion for many people, but some who suffer from such diseases as rheumatism should not eat fruits because the acids make their disease worse. Acid fruits are best in making beverages because the sour taste helps quench the thirst sooner.

But two kinds of fruits may have about the same amounts of sugar and acids, and yet taste quite unlike, as in different kinds of apples. The differences in flavor in such cases may be due to crystals dissolved in the fruit-juice. Thus the grape contains cream of tartar which is used in making baking-powder, and other fruits have other sorts of crystals.

Fruits always have a little albuminous matter in them, the material muscles are made of. Most fruits have at least a little starch—the banana has a great deal. Some fruits, like the olive, may have a considerable amount of oil in them. The dry tissue of a fruit, that which would be left after all the water, sugar, acid, etc., were taken out, is a substance like starch, and is itself good for food. There is in most fruits only a small part that is not digestible.

THE CULTIVATION OF FRUITS.

Because fruits are so very useful as food, they have been cultivated many thousands of years. We find references to them in the oldest books, like the Old Testament, and even in the times before there was any writing there is evidence that men ate fruits. At first, of course, there were only wild kinds to be had; but some of these proved better than others, and it came about that men began to take especial care of these, and when they planted seeds selected the better varieties of each. That was the beginning of fruit cultivation. Now, after thousands of years, the cultivated varieties have become very different from the original wild species. usually much larger and better

flavored. Thus, all apples are believed to come from a tiny wild one like a crab-apple.

Another great change has also occurred. If you plant the seed of any wild fruit, say a wild crab-apple, the new plants produced will bear wild crab-apples like all the others. But if you plant the seed of some cultivated variety of eating apples, take the Northern Spy for example, you will not get new Northern Spy trees; rather, the fruit will be small, probably ill-flavored, and more like the wild crab-apple than the Spy. Because of this we say that *cultivated fruits do not come true to seeds*.

Some one may wish to know how then we get new trees of cultivated fruits. Suppose we take the Northern Spy apple as illustration again, and imagine that we have a tree of this variety and want to raise more. First we must raise a lot of young apple-trees from seed; for this purpose we can use any kind of seed, even young pear-trees from pear seed will do. When these young trees are a few years old, and a few feet high, we will cut off all the stem but a few inches and then upon the stem we put good live twigs of our Northern Spy tree, binding the two cut surfaces together tightly, and sealing the place of joining with wax. This is called "grafting." If we have made our graft properly, the two cut ends will grow together, and then the Northern Spy twig will take the place of the original seedling stem, and develop a tree bearing the fine Northern Spy apples.

What is true for the cultivation of apple trees is true also for almost all kinds of fruits. Almost all of them have to be increased in numbers by grafting.

THE FRUIT CROP.

The fruit crop is one of the most important products of any land. In the United States, millions of dollars' worth of fruit are raised every year. In some States, like California, the fruit crop is probably the most valuable product of the whole State.

There was a time when only as much fruit was grown as could be used in the neighborhood where it was grown, because many fruits spoil quickly, at least in warm climates. Now, however, since refrigerator cars have been built, it is possible to ship fruit from California to New York without any spoiling. They have even been able to ship apples from far-away New Zealand to New York City for sale in summer when American apples are not yet ripe.

The fruit crop has always been valuable. We read in the Bible of the fig, the pomegranate, the vine or grape, and the olive, and we know that fruits formed a very important part of the food of the people of Bible times.

STORIES OF IMPORTANT FRUITS.

Some of our common fruits have had very interesting histories, some are interesting because of their importance. In the following pages, some of the interesting facts about our common fruits are told under the headings: (1) Common fruits of the cooler parts of the United States; (2) Common fruits from the warmer parts of America; (3) Common fruits imported from the Old World; (4) Fruits used mostly in the tropics.

COMMON FRUITS OF THE COOLER PARTS OF THE UNITED STATES.

THE APPLE.

The apple is easily king of all our fruits. More acres of land are given over to its culture, more trees are grown, and more fruits raised than of any other kind. As it happens more apples are raised in the United States and Canada than anywhere else—probably over one hundred million barrels a year. That means a barrel apiece for every one of us, although some of the crop is shipped out of the country.



1. A Red Astrachan Apple-orchard as grown in Delaware.
2. Napoleon ("Royal Ann") Cherry-tree in a California Orchard.

Apples grow best in a cool climate and in a well drained soil. The best apple region is in eastern North America, from Nova Scotia to Michigan and including the northeastern States. Fine looking apples are now being raised in large quantities in Oregon and Washington, but the flavor of the eastern apples is better. Then there are large apple orchards in eastern Nebraska and western Iowa, and others in parts of Missouri. Of course apples are grown all over the country except in the South, but the regions mentioned are best suited to their needs.

The common cultivated apple came originally from a wild kind which grows in southwestern Asia and neighboring parts of Europe. It has been cultivated thousands of years. From another wild apple now found in the same region comes the common crab-apple, that source of fine jelly. Wild apples are generally known as "crab-apples," and there are two wild crabs in the United States, but these have not been of any value.

Of the common apple there are now one thousand or more cultivated varieties, some of which are adapted to one part of the country, some to another.

Some of these kinds ripen early and are known as summer apples. Others wait till frost time to ripen, these are the fall apples. Still other kinds are not ripe and mellow even by winter time, but must be picked while hard and stored away to mellow.

If there are one thousand kinds of apples, there are also as many different flavors, ranging from the kinds so sour they make your eyes shut when you eat them to others like the Pound Sweet with almost no acid taste. Some of the summer apples have a most delicate flavor, like the Astrachan, the small Strawberry, the Sweet Bough, and a little later the Snow apple, with its deep red skin and snow-white flesh. But the early apples do not keep well, and on this account are not as useful as the fall and winter apples which

can be kept till the next summer's crop ripens. Some of the best of these are the Northern Spy, the King, the Pippin, the English Streaked, the Greening, and the Spitzenberg.

Sour apples make the best pies. Sweet apples are better for roasting or for eating raw. Cider is usually made from the poorer sorts, from the fruit of trees that have grown from seed, and these are often called cider apples, but better cider can be made from better apples.

THE PEAR.

Our cultivated pears come from two wild kinds, one from Europe, and one from China. The best kinds are from the European species; the Chinese species is useful because it will grow farther south than the other.

Pears, the best kinds like the Bartlett and Seckel, have a rich flavor all their own, but they do not keep well as the apples do, and as they ripen in the early fall when there are peaches, plums, grapes, apricots as well as apples, they have to divide our favor, and as a consequence, they are not as widely used as are apples. There are, it is true, a few kinds of pears which keep pretty well, but their flavor is poor, and their flesh tough.

THE QUINCE.

The quince looks something like a pear in shape and color, but its flavor is another thing. Don't try to eat a quince raw. There are, as it happens, a few kinds that are eaten raw, but most are very sour, and need to be boiled and served with cream or butter and sugar, or else made into jelly.

THE BERRIES.

So many different fruits are included under the name berries that it is hard to know which to tell about first. Perhaps the strawberry, the first one to

come each year as well as the best of all, deserves first place. Strawberries are grown from Alaska to Jamaica and are in season from January to July. The best berries, however, come in June, and are from the cooler parts of central New York and Michigan and other places of similar climate and soil. Fortunately these are also the most plentiful, and lowest in price, at least in the northern States. The strawberry plant is low and short-stemmed and the berries often bend over to the ground and get splashed with sand when it rains.

After the strawberries come the raspberries, both red and black, and the currants and gooseberries so fine for jelly and pie; then in August the blackberries are ripe and a little later in the same month, the blueberries and huckleberries, so good in bread and milk. All our supply of these last two comes from wild plants. Strawberries, raspberries, and blackberries grow wild, too, but our supply of these is mainly from cultivated plants. But no cultivated berry is ever quite as good as a wild strawberry.

Cranberries end the season of our native berries, and one of the best things about them is that they serve to carry us through the winter almost till the next season's strawberries are plentiful. Cranberries we associate with Thanksgiving and Christmas, with turkey and pumpkin pies. Cranberries grow only in wet bogs. Formerly only wild plants were used, but now they are being cultivated.

The mulberry, a tree fruit, is famous as furnishing in its leaves the only food the silk worm will eat, but it bears also a sweet-flavored berry much like a blackberry in shape but usually a little smaller. The fruit does not keep well, so is rarely marketed; but if one loves our wild birds, a mulberry-tree in the yard will draw many beautiful kinds to its branches daily.

THE CHERRY.

Cherries, plums, peaches, and apricots are alike in having a single hard seed, the pit or stone, surrounded by soft, juicy edible pulp. The cherry is the first of these to ripen, and comes at a time in June and July, when there are no others of the larger tree fruits. For this reason, but even more for its delicious flavor, it deserves and receives hearty appreciation.

There are two cultivated kinds as to flavor, the sweet, like the old Oxheart variety, and the sour cherries, so good for pies and as preserves. Then there are many wild kinds, some good to eat, some not. Cherry trees are often associated with Japan, the land of cherry blossoms, and some of our cultivated kinds came from there originally. As it happens, boys and girls (and grown people) are not the only ones who like cherries. The birds, the robins, orioles, grosbeaks, and many others, will always be glad to help pick your cherries.

PLUMS AND PRUNES.

Plums must always have been highly thought of, for when we want to say that such and such a man has won a fine position, as in politics, we may say "that man got the plum," meaning the finest place—likening him to one who gets the plum in his pudding.

Cultivated plums have come from several wild kinds, some from Europe, some from America, and some from Japan. Perhaps the best kinds we have are the result of the crossing of two or more wild kinds. There are five main varieties as now cultivated; first, the big red or blue ones, and the large yellow ones, which are so fine for eating raw; then there are the smaller damsons, and the green gages, especially prized for cooking. Lastly there are the kinds from which prunes are made, for prunes are only dried plums of a special kind, the flesh of which is firmer and so dries better.

Plums are made into prunes by drying in the sun or in artificially heated evaporators. To make them dry more quickly, they are first dipped in boiling lye, or run through a machine which pricks the skins in many places. Most prunes appear dark-colored. Some, however, are light-skinned, but these are probably not as good to eat as the dark ones, as they have been artificially bleached by a poisonous sulphur gas.

Prunes used to come entirely from France, but now our main supply is from California.

PEACHES AND APRICOTS.

The common peach came originally from the home land of the rose, Persia. More recently another kind has been introduced to cultivation from China. Then there is also a wild peach in the southern States but this probably came originally from plantings of the cultivated peach run wild since first introduced by the Spanish hundreds of years ago.

The peach is one of our most delicious fruits, but at the same time of the hardest to grow. In the first place, the buds are easily killed if a late frost strikes them. Then the tree is injured by fungus diseases, and by some insects. The best regions are those near large bodies of water where there is less danger from frost. There are at least three hundred different cultivated kinds of which the Crawford is probably the best.

Apricots look like peaches, and taste somewhat like them, but have an even richer flavor, and are second only to the fig in nutritive value. The home land of the apricot is in Japan and China. In the United States it will grow wherever the peach grows, but most of our apricots are grown in California, where it was introduced way back in 1792. Like prune-plums, apricots are usually dried for the market. As many as forty million pounds are shipped from California in a single year.

THE PERSIMMON.

The persimmon or date-plum is a fruit which we all ought to know better. One kind grows wild in the central and southern United States where it is highly prized, and we read of the 'possum and the 'simmon as two things the colored people especially love. There is another kind of persimmon said to be excellent which has been introduced from Japan, and we may hope before long to be able to purchase persimmons in the home markets.

GRAPES AND RAISINS.

The grape is believed by some to be the earliest cultivated fruit. References are made to it in the earliest known writings. It is also a very important fruit in commerce. If any fruit can dispute with the apple the title of leader, it would be the grape, but it is a fact, of course, that the grape finds its largest use in the making of wine and is not used for eating as much as the apple.

There are two very different main varieties of grapes. One of these comes originally from Europe and Asia. This is the grape or "vine" of the Bible, and is the one from which wine and raisins are made nowadays. The other kind is our ordinary eating grape of the autumn, and has been developed entirely from the wild grapes of America. The wine grape is familiar in one of its two thousand cultivated kinds as the Malaga or Muscat, with solid pulp from which the seeds separate easily, but with the skin firmly fastened to the pulp. In the American grape, as every one knows, the pulp is soft, and holds the seeds, while the skin comes loose easily.

Then of course we have the wine grape in the form of raisins and dried "currants," for this name is rightly that of a small kind of wine grape, the Corinth variety. The wine grape is now grown in California, both for raisins, wine, and for eating purposes.

The history of grape cultivation in America is interesting. People tried at first to grow the wine grape in the eastern States, but could not because of two serious diseases which attacked it, one due to a fungus, and one to an insect. These two pests do not occur in California, however, so wine grapes have been grown there a long time. But when it was found that the wine grape could not be grown in eastern North America, men set about improving the wild grapes native there and have now produced that delicious fall fruit every one likes, but which we might never have had if the older grape had succeeded here.

The wine grape sometimes develops enormous bunches, one of which may weigh thirty or more pounds. It must have been such a bunch as this that Joshua, Caleb, and the other Jewish spies brought back from the promised land of Canaan.

The "honey" of the Old Testament may have been a syrup made from grape juice. Whenever your mother uses baking powder, she uses cream-of-tartar, and that is a modern grape product.

COMMON FRUITS FROM THE WARMER PARTS OF AMERICA.

THE PINEAPPLE.

The pineapple came originally from tropical America and is largely cultivated there now, but it is also cultivated in the United States, and more recently in the Hawaiian Islands where most of the crop is canned. The fruit, which is the product of a whole cluster of flowers, is best when ripened on the plant, but for northern markets, it has to be picked a little green. In the South where many pineapples are grown, they are usually called "pines" for short, but of course the plant has nothing to do with the pine tree, as it is a low plant with long spiny leaves, and not a tree at all.

ORANGES, LEMONS, GRAPEFRUITS, LIMES AND CITRONS.

There are a number of fruits like the orange, the lemon, and others which have a yellowish, oily rind and a juicy pulp with usually several seeds. People speak of these together as the citrus fruits, because that is the scientific name for all of them. All of these fruits have more or less of the same kind of acid in them, and this is called citric acid.

The orange is the best known of the citrus fruits and is rightly esteemed one of the best of all fruits both because of its fine flavor and because it is very nutritious. Oranges probably came originally from southeastern Asia, from Indo-China. Now they are grown all over the world in the warmer climates. All our oranges used to come from southern Europe until it was found that they would grow well in Florida, in the Mississippi delta, and in California, where the supply is now grown for the American market.

The orange crop is now one of the largest and many different kinds are grown. There is the common seeded kind, and the less common blood orange with its red pulp, the tangerine, also with seeds, and the navel or seedless kind. The navel orange was discovered by an American traveling in Brazil. Only one tree was found originally, but this has been increased by grafting and regrafting until now more navel oranges are grown than of any other kind.

The lemon makes one think of cool lemonade, and hot summer days, and of circuses and county fairs. Perhaps, too, some of us remember taking the juice hot just before going to bed, when we wanted to break up a cold.

Lemons used to be grown largely in Florida until an extra hard frost one winter killed most of the trees. Now most of the supply comes from California. Lemons are grown in great quantities in southern Europe, and much more cheaply than in California, but the tariff or tax on imports keeps foreign lemons out of the American market.

In the tropics they often use another citrus fruit, the lime, for making drinks instead of the lemon. We in the North know this fruit chiefly in the form of that candy the druggist keeps—lime-drops, or in preserves and pickles.

Another citrus fruit which we know better is the grapefruit, so called because it grows in grape-like clusters and has a similar flavor, but the name is a poor one. There are numerous varieties of the species to which the grapefruit belongs, and they grow all over the tropics and have various names; some of these are pomelo (that is, “apple-melon”), the “forbidden fruit,” the fruit of Paradise, the shaddock, and others. Some of these are delicious fruits. Some are not good to eat at all. Indeed one variety of shaddock is used to scrub floors with because its juice will drive away fleas which are often very numerous and troublesome in hot countries.

Every one knows the citron, another of the citrus fruits of which the rind is used in preserves.

Probably not so many have ever eaten that delicious little Japanese fruit, the kumquat or kinkan, a little orange-colored fruit the size of a small plum and which is sold by the quart. The pulp of the kumquat is sourer than any lemon, but the rind is of a sweet flavor, and when eaten with the pulp makes a pleasant fruit.

THE BANANA.

The banana is one of the most useful plants grown, and probably supplies more people with food than any other fruit. But the people who eat the most bananas are not the boys and girls and older people of the United States and Canada. We may think we eat a great many, but how would you like to have little else to eat much of the time? That is the case with people in some parts of the tropics where the banana grows wild as in Africa. They use the plantain, a kind

of banana, as a vegetable, cooking it in various ways and eating it as we eat bread, meat, and potatoes. Bananas have in them a great deal of starch, and can be dried and ground to make flour. Banana-flour is likely some day to become a valuable product.

For eating raw, bananas should be selected which are very plump and ripe, as unripe bananas are hard to digest. They are really best for us, and taste best too, when the skin has become brown, provided of course, the pulp inside stays light colored.

The bananas which we buy come from the West Indies, from Mexico, and from Central America. A very few are grown in southern Florida. For sending to us, the fruit is picked very green, and allowed to ripen in storage.

COMMON FRUITS IMPORTED FROM THE OLD WORLD.

THE OLIVE.

The olive is a valuable fruit which has been cultivated thousands of years. In the Old World, in parts of Europe and Asia where it grows wild, it has many important uses. The fruit is eaten fresh or pickled, or the oil is pressed out to serve as butter does with us. That was one of its uses in Palestine at the time of Christ. Then, too, it was used to make various kinds of ointments.

It is now being grown in California where the fruit is usually pickled ripe. The ordinary bottled olives we see in the eastern markets are imported from Europe, and are the green, unripe fruit. The ripe ones are much more nutritious.

Olive oil is a very important product of the olive, and this is one of the few fruits in which oily matter is present to any large extent. Most of the so-called "olive oil" used to be made from cottonseed, but now since the Pure Food Law was passed, there is probably far less adulteration.

THE DATE.

The date comes to us from the land of the fleet Arabian horse, and from the land of the Bedouin in Northern Africa, where the trees are cherished possessions. The tree is a tall palm, sometimes one hundred feet high, with large plume-like leaves. The ordinary date is the dried fruit. If you want to know what a young date palm looks like, you can easily grow one by planting in a flower pot in ordinary soil one of the hard pits or seeds of a dried date.

THE FIG.

The fig is the first kind of fruit tree named in the Bible. It has certainly been under cultivation a very long time, not only in its original home in Asia, but in other places where the climate and soil are favorable. It is interesting to know, too, that the fig is the most nutritious of all our fruits.

There are three varieties usually cultivated, and these are useful in three very different ways.

The first, known as the garden fig, is grown for its fresh fruit. This is now cultivated in California, but to so small an extent that the fruit rarely appears in the markets.

The common dried fig of commerce is what is known as the Smyrna fig. The fruit of the third variety, the Capri fig, is never eaten, but it is none the less necessary to have trees of this growing with the Smyrna fig if the latter is to set fruit.

The reason is most remarkable and has to do with a small wasp which regularly lays its eggs and rears its young in the flowers of the Capri fig. This is a very good arrangement for the wasp, for its young are thus provided with plenty to eat, but it is also a good arrangement for the fig. The advantage to the fig comes from the fact that the wasp in laying its eggs flies from flower to flower and thus carries along from one flower to another the pollen without which the

flowers can not ripen into fruits. Now for some reason, the wasp can not rear its young in the flower and fruit of the Smyrna fig, but the wasps do not seem to know this, for they will lay eggs in a Smyrna flower quite as readily as in the Capri kind. At the same time, of course, they bring pollen, and this makes the Smyrna fig ripen, but the eggs which were laid in it at the same time never develop, so that unless there are Capri figs in the neighborhood, in another year there would be no more wasps, and so no more Smyrna figs.

For a long time they were not able to ripen Smyrna figs in California although the trees have been grown there for a century or more. Finally, however, they succeeded in introducing the little Capri wasp with the Capri fig, and now fig growing is likely to become an important industry in the Garden State.

FRUITS COMMON ONLY IN THE TROPICS.

In the tropics, foods like meats, and starchy foods like potatoes which heat the blood are not eaten as much as in cooler climates. Fruits on the other hand are eaten a great deal more, both because of their cooling effects, and because they are plentiful and of many kinds. There are, indeed, so many kinds of tropical fruits that only a few can even be mentioned here. There is no space to describe the mangosteen, called the finest fruit of the eastern tropics, with a flavor combining the best of the grape and strawberry; nor the cherimoyer, considered the best of sub-tropic fruits. The very names of many of these fruits are mysterious and attractive; like tamarind, custard apple, alligator pear, and many others. A few tropical fruits, however, are especially well known.

THE POMEGRANATE.

The pomegranate, one of the few fruits named in the Bible, comes from a small tree, originally from

Asia and Africa, but now widely cultivated in the tropics. The fruit is rather large, oblong, with a thin skin enclosing numerous large seeds, each with a thin covering of red, acid pulp. The pulp may be eaten, or used to make a fine cooling drink.

THE GUAVA.

One of the things travelers usually bring from the West Indies is guava jelly. The guava itself is a small bush fruit of an acid taste. The plant grows throughout the tropics, and to some extent in California and Florida. Besides its use for jelly and preserves, the guava may be eaten raw and early morning is said to be the best time to eat it because then it is less acid.

THE MANGO.

The mango, one of the better known tropical fruits, came originally from Asia but is now grown in America, in the West Indies, and in parts of Florida and California. The fruit has a tough rind with a soft pulp and one large seed. It is eaten in a variety of ways; either pickled green or in preserves and jellies, or ripe and fresh, or sliced in wine, sugar, and nutmeg. It is said that a taste for the fresh fruit has to be acquired, as there is often a sort of turpentine flavor.

THE PRICKLY PEAR.

One of the tropical fruits of especial interest to Americans is the prickly pear, one of the cactus fruits. All kinds of prickly pear plants, and there are many, came first from America where they form one of the odd features of desert scenery. Many years ago, however, they were taken to Europe and later to Asia, Africa and Australia, and now they are so much at home there that travelers often think of them as belonging there. In some Old World countries they are very dangerous weeds.

In Sicily, however, the cultivation of two or three of the best kinds is an important industry. Some of the fruit, called prickly pears, Indian figs, or tunas, are sent regularly to American markets. The fruit as it comes to New York is usually oval, often colored yellow or with a red flush like a pear, but with clusters of tiny bristle-like thorns, from which the name comes. Inside is a sweetish pulp with numerous small seeds, without any marked flavor.

THE BREADFRUIT.

The breadfruit, our geographies tell us, is a very important source of food in tropical lands, especially in the islands of the Pacific ocean. It came from the Pacific regions originally but has now been introduced all over the tropics.

The plant is a tree with very large leaves. The fruit looks like a large osage orange, that is, it is large and round like a big orange, but with an uneven surface. Inside it has a white starchy pulp which is the part that is eaten. It is always cooked in some way first, and then may be eaten with coconut milk, or without, or allowed to ferment a while before eating. It surely is bread for many people in the tropics, but it is a fruit only in the technical botanical sense, and not as are oranges, bananas, etc.

CHAPTER VII.

The Edible Nuts.

UTS we have decided are almost always just seeds, consisting of a kernel or meat encased in a hard shell. Some so-called nuts, like the peanut and coconut are not strictly included in this definition, but we need not go into technical distinction.

The common nuts, like the fruits, come to us both from temperate and tropical regions. There are, however, many fewer kinds of useful nuts than of fruits. Then, too, fewer kinds of nuts are cultivated and a much larger proportion of our supply comes from wild trees. The nut crop is comparatively small and probably does not equal, including all kinds, the crops of any two or three of the more important fruits.

Nuts are, however, very nutritious. Like fruits they contain water, sugar, starch, proteids, crystals, acids, oils, and cellulose (the pulp part), but the proportions of these substances is very different from that in fruits. For example, there is very much less water in nuts. That means that in the same weight of fresh nuts and fruits, there is much more solid nourishment in the former. For another, there is usually less sugar, but almost always more oil, and the latter ingredient makes nuts richer and harder to digest. It also makes them bad things to drop on the carpet, as your mother has very likely told you. Nuts usually have considerable amounts of muscle-forming proteids. People who study the composition of various foods tell us that many nuts have just about the right proportion of the different materials which go to make up the body so they are really one of the best kinds of foods. A little salt eaten with them helps both their digestibility and their palatability.

Almost all nuts grow on trees—the peanut is the only common exception—and as most of our nut trees are large, it has not been easy to bring them into cultivation as with the smaller fruit trees. Recently, however, much interest has been taken in nut culture, and more planting is being done. As it happens, most of the cultivated nuts have been introduced from abroad. The pecan is reckoned the best American nut for cultivation.

THE PEANUT.

The peanut is surely the commonest of all nuts. In this case the real nuts are the brown-wrapped seeds inside the yellow shell. This shell is much like a pea pod and the name “peanut” is really very good on this account since peas and peanuts belong to the same family of plants.

The story of the peanut has some very interesting features notwithstanding the fact that it is so common and poorly considered as to stand for very small or cheap things, as when people speak of “peanut” politics. The way the peanut grows is most peculiar. Many people, knowing that it ripens underground, think of it as a root product, but it is really as much a flower product as any nut or fruit. The plant is a low herb and the flowers arise near the ground, but at first they grow like any flower. Later, however, the stem bends over and pokes the young peanut pod into the soil, because that is where the pod can ripen best. There it grows to be a full-sized pod with one or two or even more seeds in it.

Peanuts are grown mostly in the southeastern States, but they will grow almost anywhere in the United States, and any one with a foot of ground, or even a large pot or box of soil, can grow a peanut plant, and see how the flowers bend over. But don't try to grow roasted peanuts. Get the nuts before they are cooked, and plant the seeds without the shell.

THE COCONUT.

Coconuts (also spelled "cocoanut"), are like dates, borne on tall palms. In the story of *Swiss Family Robinson*, we are told that the easiest way to pick coconuts is to find a good tree with a monkey in it, and then to throw stones at the monkey who will be led to imitate your actions and throw coconuts down. I doubt whether many coconuts are gathered in that way, but I am sure all boys would like to try the method some time.

As a matter of fact coconut means "monkey nut," and the name comes from the fact that one end of a cocoanut has always three spots which look something like a monkey's face. Perhaps that is why a small boy sometimes speaks of his head as his "coco." Of course coconuts have nothing to do with cocoa or chocolate.

There are many very interesting facts about the coconut. It grows every where in the tropics, and no one knows where it originally came from. The nuts, of course, have a big air space inside which makes them float, and as the coconut palms usually grow near the water's edge, the nuts sometimes fall in and so may be carried from one island to another. Here it may be washed up by a wave to a place where it can sprout and develop into a new tree. The coconut shell is so very thick and hard that it would be difficult for the young plant to force its way through were it not for the three spots in one end which mark softer places through which the young stem and root can, when ready, push out.

Every part of the coconut is useful. The next time you wipe your shoes on one of those fibrous yellow door mats you may know you are using a part of the coconut, for door mats are made from the thick husk which surrounds the ordinary coconut as we see it. The hard shell is often used to make drinking cups in the lands where the coconut grows. The milky juice inside is drunk either fresh or fermented. Of course

the meat inside is the most valuable part of all. Besides being eaten fresh or used to make pies, cakes, and candies, the meat contains a valuable oil. One of the main articles of commerce on most of the islands of the Pacific is copra, the dried meat of the coconut which is shipped to Europe to have the oil pressed out. In Chapter IX you will find some account of the many uses of the coconut tree.

THE WALNUT.

There are several kinds of walnuts and sometimes the name is applied incorrectly to hickory nuts, but more about these later. The best known walnut is the one called the "English walnut" which, as it happens, comes from Persia and the lands around the Caspian Sea. It will grow almost anywhere in the United States except in the colder parts, but California has the best climate for it. The English walnut is considered the best because of its thin shell which can be cracked so easily.

In the United States there grows wild another walnut, which has a much thicker, harder shell, but at the same time a richer meat. This is the black walnut. It used to be a very common tree in our country in the early days, but the first settlers burned off great forests of it in order to get land to cultivate and now the trees are not common anywhere.

THE BUTTERNUT.

The butternut, really a kind of walnut, is as rich and oily as its name would indicate. It also has a thick hard shell, not easy to crack, and butter nuts are not very common in the market.

THE HICKORY NUT.

Hickory nuts are often called walnuts, and are really much like them as every one will recognize, but is there any nut as sweet as that of the shag-bark

hickory? There are, however, some poor tasting hickory nuts, the pignut and especially the bitternut. Then there is the mocker nut, a sweet-meated hickory nut, but with a husk and shell so hard to break that the labor is scarce repaid. In the Middle States, there is a very large sweet hickory nut, the shell-bark, not, however, as good as the shag-bark.

THE PECAN.

The pecan is really a kind of hickory nut, and is the only American nut which has been cultivated very much, although most of the market supply still comes from wild nuts. It makes a particularly good nut for the market because it has a thin shell as well as a sweet meat, but the latter is sometimes marred by the bitter brown inner skin which can easily be overlooked in picking out the shell.

THE CHESTNUT AND THE CHINQUAPIN.

Chestnuts, stale jokes and twice-told tales! One can't see how such an association can have arisen, certainly not in connection with fresh chestnuts, one of our sweetest nuts. Perhaps it started with reference to old dried chestnuts, but even these can be made very good to eat merely by boiling.

There are several kinds of wild chestnuts, the American, the Japanese, and the European. The last two have been cultivated a good deal for their large meaty nuts, but the smaller American nut has a much better flavor. All three kinds are good cooked.

The American chestnut is in danger of being entirely killed off by a fungus disease which started a few years ago, apparently near New York City. Already thousands of trees have been killed. In New York City itself, probably not one large tree is left. If this disease spreads wherever the chestnut grows, it will mean a very serious loss for the chestnut is a particularly valuable timber tree.

The chinquapin is a sweet little chestnut which grows on bushes found in the southeastern United States.

THE ACORN.

Probably a good many people do not know that acorns are good to eat—some acorns at least. Some kinds like those of the white oak, to mention only one, are decidedly sweet and well worth trying if the squirrels leave any for you. Other kinds like those of the red oak, and the black oak are bitter and you can usually find many of these on the ground as the squirrels do not eat them. The sweet acorns are esteemed fine feed to fatten turkeys.

THE BEECH NUT.

Beech nuts are about the smallest of all our nuts and perhaps the least known. The nuts are three-cornered affairs about the shape of a buckwheat grain and not a great deal larger but the kernel inside is very sweet-flavored.

THE FILBERT OR HAZEL NUT.

What one of all the nuts is more satisfactory than the filbert? One cracks open the solid little shell and then inside is such a hearty, solid, sweet meat. There are perhaps a dozen kinds of wild filberts or hazel nuts, some from America, some from Europe, and some from Asia. The plants are mostly trees or bushes, and the best kinds are cultivated, more in Europe than America.

THE ALMOND.

The almond has been cultivated a very long time, perhaps as long as the oldest fruits. It probably came from the Mediterranean region originally, but now is very wide spread in cultivation, and will grow almost wherever the peach is found. It is really a close rela-

tive of the peach and apricot and corresponds to the pit or stone of these fruits.

One kind of almond has, as already mentioned, a poisonous acid in its meat known as prussic acid, but which can be used in small amounts in flavoring. This is the bitter almond. The almond we eat is the sweet kind, and the best kind is known as the paper-shell on account of its thin shell.

THE PISTACHIO NUT.

The pistachio is best known as the flavoring of certain green candies, and green ice-cream. The nuts themselves are bright green inside. Sometimes one can buy them salted down in their thin shells. Most of the kinds come from Persia but there is one kind found wild in Mexico, and they can be cultivated in California.

THE BRAZIL NUT.

The Brazil nut has several other names; Para nut, from the Brazilian city of Para, from which most of them are shipped, nigger-toe from the shape and color of the brown-skinned meat inside the shell, and cream-nut because of the rich and oily flavor, something like that of the coconut. The tree grows along the Amazon and requires too hot a climate to be cultivated in the United States. The nuts are borne several clustered in a small round case.

THE COLA-NUT.

The cola-nut grows wild in tropical Africa and now is being cultivated in the West Indies. It isn't used regularly for food, as we use our native nuts, but to make medicines and drinks, and the Africans eat it when they want extra strength in performing feats of endurance.

THE BETEL NUT.

One hundred million people chew the Betel nut!

What is it? The seed of an East Indian palm tree which grows commonly in southeastern Asia, in

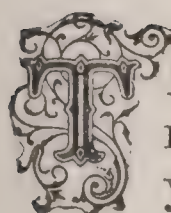
the Philippines, and in the Malayan islands generally. The brown people who live there are very fond of it, and chew it constantly much as many people in America chew gum or tobacco.

The trees are fairly common. As one finds them in the forest, a loose circle of rope will often be seen about the bottom of the trunk. This the natives use when they want to climb the smooth stem for the nuts. The nut is borne inside an orange-red husk about the size of a small egg. The meat is whitish, not unlike coconut meat, and has some medicinal properties. In addition, if chewed constantly, it has the effect of turning the teeth dark brown. As many of the natives are fond of filing their front teeth so as to make them sharp-pointed, one can imagine the effect of a smile.

Before it is chewed, the nut is wrapped in the fresh leaves of a kind of pepper plant, and sometimes a kind of gum is added to make it last. Some of the natives chew tobacco and betel-nut meat at the same time, and as they are not usually careful to keep the combined juice inside their mouths, it often gets on the chin turning it a strong red.

CHAPTER VIII.

The Spices and Condiments.

 HERE is a class of food-stuffs that really are of no use, considered merely as nourishment, and yet they have for ages been used by all peoples to make their food more tasty, or to preserve it. It is only of late years that the experiments and studies made upon diet have shown how very valuable are these substances, considered even as additions to the food, and without speaking of their value in preserving food-stuffs from spoiling. It has been found that as soon as the sense of taste is pleased and interested, or pleasantly excited even by thinking of an agreeable flavor, not only does there happen the “watering of the mouth” such as we all know results from thinking of anything good to eat or drink, especially if it be pungent and spicy or strongly acid, like a lemon, but there also take place other changes throughout the body preparing it for the digesting of food.

Formerly it was thought that the desire for spices was an unnatural taste, and that they were unnecessary; but this has been shown to be a mistake, unless the use of them be carried to an excess. One would have thought that the example given by the desire for salt, which has no food-value, would have shown that there were other uses for food-stuff besides nourishment.

We may, therefore, consider the long list of spices and other condiments, used only to please the palate, as containing substances having an important part to play in the feeding of mankind.

WHAT SPICES ARE.

A little examination will show that the strong flavors and essences yielded by plants have been of use to the plant in preserving it from the attacks of insects or small creatures that would destroy it. Oils, essences, and strong secretions are made in the seeds, roots, leaves, or bark of plants to make them unpleasant eating for creatures that would prey upon these. And very unpleasant eating they are, in large quantities; but in small quantities they excite the palate, please the sense of taste by stimulating it, and so are grateful to us.

As these substances repel insects from the plants in which they are found, so they can be used for the same purpose in preserving foods from similar attacks.

THE IMPORTANCE OF SPICES IN OLD TIMES.

Today, when we have so many means of keeping food, as, for instance, cold storage, or by the use of ice or freezing-mixtures, by canning, preserving, and so forth, we do not need spices for this purpose, and in using them think mainly of their flavor. But our forefathers had to keep meat and fish and vegetables simply by smoking or drying or by using spices. Thence it came about that people were then accustomed to eat many things very strongly flavored, and so enjoyed peppered, salted, or spiced food we should find far too strong for our tastes. In old times vast quantities of spices were used, and since many of them came from the far East, they were very expensive because of the charges for transporting them. Merchants made rich profits in the spice trade and underwent great risks, because the sea-routes were long and dangerous, and the routes over the land also were infested by robbers, were toilsome, and could be traversed only by pack-animals, in strongly guarded parties.

The rich rewards reaped by Eastern merchants induced navigators to look for shorter routes to India,

and the hope of this profitable trade was one of the chief causes leading to the discovery of America.

In old times also, much larger quantities of fish were eaten in proportion to the number of people, owing to the strict church rules kept by all Christendom, and owing to the relative scarcity of meat, especially in the summer time, when it could not well be kept.

All these causes made a great demand for spices and increased people's appetites for them.

Salt was available on all seacoasts, but pepper and such spices as cinnamon, cloves, nutmeg, and the like, came chiefly from tropical countries.

From what has been said, it will be seen that these protective essences in plants are usually found in more important parts, as in the seeds and bark, which are exposed to insect attack. Among seeds which are used for spices there is a great variety, by far the most important being pepper, because of its sharpness and the fact that a little goes so far.

DIFFERENT KINDS OF PEPPER.

Both the black and white pepper ordinarily used come from the same plant, known as the pepper plant, found in southern Asia and the islands nearby. It has been imported since the very earliest times, and was known to the very earliest botanists among the Greeks and Latins. It came, by caravans, through Arabia, over the Red Sea to Africa, and then across the Mediterranean in ships. It was heavily taxed by those who exported it, and also in the countries where it was used. Only the rich could readily afford it. In the seventeenth century the tax was as high as five shillings a pound, in England.

The pepper is made from the seed, which turns black in drying. White pepper is made by bleaching the outer skin. The oil that gives pepper its strong flavor lies chiefly in the outer skin of the seed, which is

removed before making the white pepper, so that white pepper is much weaker than the black. In the early days of its use it was highly regarded as a medicine to help digestion.

RED PEPPER.

This spice is prepared from the capsicum plant, a tropical herb. There are three or four different species, differing in the strength of the pepper they produce. This sort of pepper was first found in America, on the second voyage of Columbus, but has gradually been introduced into whatever countries have a suitable climate. It grows best in the West Indies, Central Africa, and southern Asia. The table pepper is made of the fruit, ground and dried. Besides its use as a spice, it has valuable qualities as a medicine, and is also used as an application to the skin, in liniment.

It is often called Cayenne pepper, the adjective being the name of the country that was thought to furnish the best quality.

Capsicum, the name given to the plant by botanists, may come either from the Greek word for a box or chest, since the seeds are held in pods, or from the Greek word for strong, because of its pungency. It is believed by farmers that red pepper fed to hens causes them to lay more eggs.

Another form of red pepper, much weaker than cayenne, is known by the Hungarian word "paprika." It is made from a cultivated variety of the same plant, the seeds being removed before grinding the fruit. The word is also used to mean dishes prepared with this spice.

MUSTARD, ENGLISH AND FRENCH.

Mustard is the seed of a plant which is very closely related to the cabbage family, both varieties going by the same Latin name. There are three ordinary varieties, called black, white, and wild mustard. In order to prepare it for the table, the seeds are crushed and

sifted, and then made into a paste by the use of vinegar or water. The old name for grape-juice, and hence of wine and vinegar being "must," gave us the name now applied to this seasoning. According to the method of preparation and flavoring, mustards differ in strength and in use. That known as French is weaker than what we call English mustard, and contains less of the crushed seed, with more salt, sugar, and vinegar. Besides its use on the table, it has long been valuable in medicine for making plasters to be applied to the skin to bring blood to the surface.

The plant is most largely grown in the tropics, and much of it is prepared in Europe, whence it is sent all over the world. It is one of our oldest spices and medical remedies. When first powdered, the seeds have no very great strength, but warm water being mixed to make a paste, the paste ferments, producing an oil, which is declared to be the most pungent of all known substances. To make the best mustard, both white and black are used.

The family of plants to which the mustard belongs, the cruciferæ, includes the cabbage, kale, cauliflower, turnip, and some other vegetables. Indeed, the leaves of the young mustard plant can be used as tablegreens or as a salad. The mustard-seed is mentioned in the Bible as an example of minuteness.

CURRY.

It is only within a generation that curry powder has been at all generally used upon our tables in America. It has long been valued in the East, and knowledge of it was brought home from India and elsewhere by colonials. The name is applied to a number of different mixtures of spices, the original word meaning simply sauce, or relish. In the East, many of the people live largely upon somewhat tasteless or insipid vegetable foods, to which such a relish is necessary.

To prepare curry powder, there are various mixtures, nearly all the well known spices being employed at one time or another. Curry, therefore, is not a true spice in itself, but simply a mixture of spices of various flavors. The powder is prepared in India, freshly for each day's use, which gives, it is said, a superior product. But the ordinary curry-powders sold in our markets are made by grinding, mixing, and bottling whatever spices may be selected for the purpose.

There is not enough difference among the different kinds of other spices to make it worth while to describe each separately. It will be seen that a large class of them consist either of ground seeds or of seed coverings, or the entire seed may be used. Another class, like cinnamon, is made from the strongly flavored barks. An instance of a flavored leaf being used is found in mint, thyme, sage, and others of this class. Spicy roots are the ginger, the horse-radish, and the asafoetida, though the latter is strictly the juice of the root. Though extremely disagreeable when used in any quantity, a very minute portion of this strong drug seems to give a delicious flavor, and it is believed that certain celebrated table sauces made by secret receipts are relished because of its presence.

Of course there are still other substances used as flavorings, of which we may mention the walnut and the pistachio-nut, but the general purpose of their employment is the same as those already mentioned, and we have already described the most familiar.

The following little table will show from what parts of plants our spices are derived:

From the Seed.	From fruit or flower.	From Seed Cover.
Anise.	Vanilla.	Allspice
Pepper.	Caper.	(from Pimento).
Caraway.	Clove.	Mace
Cardamom.		(cover of Nutmeg).
Coriander.	From the Leaf.	
Cumin.	Parsley.	From the Root.
Fennel.	Sage.	Asafoetida.
Mustard.	Mint.	Ginger.
Nutmeg.	Thyme.	Horse-radish.

CHAPTER IX.

Vegetable Foods and Food Products.

 HE food-supply of the human race is endlessly varied; yet, with the exception of the water which we drink, the air which we breathe, and the salt which we add to our food, all that nourishes and maintains the body may be grouped into two general classes: animal foods and vegetable foods. Food is necessary, not because it satisfies the sensation of hunger and contributes to comfort and pleasure, but because it supplies the material from which the body is built and with which it is kept in repair, and also the energy which runs the body-machine and enables it to do work.

WHY FOOD IS NEEDED.

The functions or uses of food, then, are to build and repair the tissues of the body, and to supply bodily energy.

Though the organs and tissues are of such varied appearance, all parts of the body, whether it be the teeth and bones, the soft flesh, or the hair and nails, are made up of a comparatively small number of chemical elements. Among the non-metallic elements are oxygen, hydrogen, nitrogen, carbon, phosphorus, sulphur, and chlorin; of the mineral elements, iron, calcium, magnesium, potassium, and sodium are the most abundant. The elements which make up the body are found in various combinations in food-products; and those we need are selected by nature from the supply provided by processes which very often we can not explain, and which are a part of the great mystery we know as "life."

It has been found that, for convenience, the great

variety of compounds in which the elements occur in the body and in food-products may be divided into a small number of groups, namely: water; protein or nitrogenous material; fat; carbohydrates, and ash.

WHAT FOODS CONTAIN.

Under the term *protein* are included all the nitrogenous compounds, such as the gluten of wheat, the white of eggs, and the lean of meat; and under *fats* such substances as oils (as olive, cotton-seed and corn oil) and such animal foods as butter, lard and suet. Under *carbohydrates* are included sugars of different sorts, starches, and the various materials which make up the rigid or the woody parts of vegetable products; and under mineral matters or *ash*, a great variety of mineral salts, as sodium chloride (or common salt), calcium phosphate, magnesium phosphate, and compounds of potassium, of iron, and of sulphur.

All tissues contain nitrogen, and so the nitrogenous compounds are essential for the growth and repair of the body. The nitrogenous compounds also supply some of the energy which the body requires, and so serve a two-fold purpose. However, the chief energy-yielding constituents of food are the compounds free from nitrogen—fat and carbohydrates. Mineral materials enter into the body structure as in the bones and teeth, and are important to the work of the system in many other ways.

HOW ENERGY IN FOOD IS MEASURED.

The unit which is used in estimating energy values is the calorie. This represents the amount of heat required to raise the temperature of a pound of water 4° Fahrenheit, which is equivalent to 1.54 foot ton.* As sources of energy, protein and carbohydrates are theoretically equal, each yielding 1,820 calories per pound,

*Note: That is, it equals the work done in *lifting* a ton a little more than a foot and a half.

while fat furnishes about $2\frac{1}{4}$ times as much energy, or 4,080 calories per pound.

It has been estimated that the body of a man five feet eight inches high and weighing 154 pounds contains about 96 pounds of water, 24 pounds of protein, or nitrogenous material, 23 pounds of fat, and 3 ounces of carbohydrates (such as the glycogen which is found in the liver), while the remaining 10 pounds and 13 ounces is made up of the phosphate of lime, carbonate of lime, and other mineral salts.

To supply the needs of the body and keep it in repair it has been estimated that an adult man of average height and weight requires in the food which he eats per day 3.5 ounces of protein, and carbohydrates and fats enough to supply with this quantity of protein 3,500 calories of energy, as well as about two-thirds to three-fourths of an ounce of animal matter.

MAN'S CHOICE OF FOOD.

In earliest times man depended entirely upon wild roots, plants, seeds, game, and fish for his food. Later the race learned to cultivate a few plants and domesticated a number of animals, and so obtained a food-supply which was more or less under control. As time has passed, increasing dependence has been placed upon a cultivated food-supply, until at the present time we depend almost exclusively upon the crops of farm, orchard, and garden, and upon our flocks and herds; though we still take our sea-food from the oceans, lakes, and streams, as nature provides it, and gather a few wild plants for salads and pot-herbs, and some wild berries, fruits, and nuts.

The kind of food man uses is determined by circumstances. Thus the Esquimo and some of the natives of the southernmost part of South America live almost exclusively on animal foods, since they can procure little else. Yet that the Esquimo prizes vegetable food is shown by the greediness with which he consumes

the lichens and green plants that grow in the brief Arctic summer, or even the vegetable material found in the intestines of animals which he has killed.

There are dwellers in the tropics who live very largely upon vegetable food, perhaps because it may so readily be obtained in such varied character.

Setting aside these extremes, the majority of the human race lives on a mixed diet made up of animal and vegetable foods, and has apparently always done so, the kind and proportion of each class being determined by the available food-supply.

WHAT AN AMERICAN FAMILY EATS.

The diet of the average American family contains, on an average, 61 per cent of food materials of vegetable origin, and 39 per cent of animal foods.

On an average 97 per cent of the protein, 95 per cent of the fat, and 98 per cent of the carbohydrates of the total animal food in a mixed diet are useful to the body, while 89 per cent of the energy is available. In the case of vegetable foods, the values are: protein, 84 per cent, fat, 90 per cent, and carbohydrates, 97 per cent, with 92 per cent of the energy available.

Generally speaking, there are certain differences in the character of the two great groups into which food products are divided. Thus, vegetable foods are characterized by the presence of carbohydrates, usually accompanied by varying amounts of protein, fat, or both; while the animal products are characterized by the presence of protein and fat, with small amounts of carbohydrates in a few cases only.

It will be convenient to set these figures down so they may be compared:

	Protein	Fat	Carbohy- drates	Energy
Animal Food.....	.97	.95	.98	.89
Vegetable Food.....	.84	.90	.97	.92

ORIGIN OF CULTIVATED FOOD PLANTS.

The origin of very many of our cultivated food plants is a mystery, and no one can say with certainty what the wild form of wheat or barley was like, or what race or tribe first cultivated the wild apple and improved it in size, flavor, and quality. The bulk of the plants which are in use as food are natives of the Old World. Of those which the New World has contributed, there are two which are of very great importance, and whose use has become almost universal, namely, the potato, and Indian corn, or maize.

The potato, which had apparently been grown in South America for centuries before the white men found it there, was introduced into Europe between 1580 and 1585 by the Spaniards, and afterwards into England at about the time expeditions were sent by Raleigh to the Virginia country; and it slowly made its way into popular favor. It is believed to be a native of Chile where a wild plant is still found which much resembles it.

The American Indian, though he is usually thought of as a hunter, and as more or less of a nomad, had nevertheless learned to cultivate crops; and he raised beans, squashes, sunflowers and other plants, as well as Indian corn. His method of fertilizing the corn by burying a fish with the seed in each hill was adopted by the earliest settlers, and the use of fish fertilizer is still followed. The early chroniclers tell us that the Indians had comparatively large areas of corn under cultivation when America was discovered. The early settlers took kindly to this grain, and to the Indian methods of preparing it; for the making of such common dishes as hominy and succotash was learned from the Indians.

Indian corn was probably a native of the warmer regions, in tropical or sub-tropical America; yet by cultivation, and the selection of seed through centuries, the Indians had so changed it that varieties had

been produced which grow as far north as Canada—a clever work of which the most skilful plant-expert at the present time might well be proud.

Corn has now become one of the very important world-crops, and though there are still localities where it is not much used, it is grown in enormous quantities in Africa, Asia, Australia, and southern Europe, as well as in the United States. It may be said with truth that this plant is the Indian's great gift to the world.

THE OLDER FOOD PLANTS.

Onions, or leeks, apples, figs, grapes and many food plants are older than any civilization of which we know. In ancient Rome, cabbages and beans were common, as were many other cultivated crops. For centuries the food-supply of Europe was made up largely of grains, meat, fish, and poultry and some of the coarser roots, and Holland was long distinguished from other countries by the fact that the Dutch gardeners and farmers raised a comparatively large number of vegetables. It is said that it was not until after the arrival of Queen Henrietta Maria (about 1625) that green vegetables or "salats," as they were termed, became common foods in England. She so pined for the green vegetables of her native land that the King brought gardeners from Holland to lay out a vegetable garden at Hampton Court.

The Dutch settlers of Manhattan Island carried their love for green vegetables to their new home, and were much noted as gardeners among the pioneer settlers of this country. It is claimed that besides raising the carrot, turnip, parsley, and some other vegetables, they introduced the cultivation of the potato into North America. They added to their list of green food plants many native plants whose use they learned from the "Wilden," as they called the Indians.

Today the list of vegetable foods is a very long one, and is being added to, from time to time, as agricultural explorers find new plants which seem promising. On the other hand, each country has its favorites, and the list of vegetable foods which any family uses regularly is not nearly so long as it might be.

SOME NEWER FOODS.

As an instance of food-products which have become staple articles of diet within recent years may be mentioned the grape-fruit, or pomolo, which was hardly known, except in a few localities, twenty-five or thirty years ago; and the banana, one of our most common fruits today, and yet fifty years ago a rarity outside of the tropics.

A wild plant which is interesting because it is coming under cultivation, and may in the future become an important cultivated crop, since it can be grown in marshy areas, is the wild rice of our American lakes and rivers. This grain, which is about the size of wheat or ordinary rice, has been gathered and used as food by the Indians since early times. The white settlers learned its use from them, and while it has always been eaten in a limited way, it is today rather favorably known as a high-priced luxury.

CLASSIFICATION OF VEGETABLE FOODS.

For convenience, the vegetable food-supply of the human race may be divided, chiefly on the basis of outward character and of uses, into a number of general groups, though the divisions are more or less arbitrary, and overlap each other. These are: *cereals*, and other dried seeds which are used in similar ways; *vegetables*, both green and ripe; *fruits*; *nuts*; such separated vegetable foods as edible oils, sugar and honey, starch and vinegar; and, lastly, vegetable products used for making beverages, as tea, coffee, chocolate and cocoa.

An idea of the relative value of the different classes of vegetable foods in the average American diet may be gathered from the fact that cereals and their preparations make up 21 per cent (nearly one-quarter) of the total food supply; potatoes, beans, peas, and other vegetables, 20 per cent (or a fifth); fresh vegetables, 4 per cent (one twenty-fifth); and nuts and miscellaneous vegetable products, 1 per cent (or one-hundredth). To this may be added, sugar, molasses, etc., which supply 5 per cent (one twentieth) of the total food.

THE CEREALS AND THEIR PRODUCTS.

The cereals, strictly speaking, are grasses, and include wheat, barley, rye, rice, Indian corn, kaffir corn, emmer and spelt. According to common usage, the group also includes such seeds as buckwheat and sesame. All these seeds contain little water, and much starch, with protein and fat in varying proportions in different grains, and fair quantities of ash or mineral matter.

The reasons for the extensive use of cereals and cereal products are not hard to find. Besides being cheaply and easily grown, the grains contain unusually good proportions of the necessary food ingredients, with only a very small proportion of refuse. They are also readily prepared for the table, and are palatable and digestible. Owing to their dryness, they are compact, and easily preserved without deterioration.

After gathering, the cereal grains are allowed to dry for a certain time, and are commonly prepared for use by milling, in which process the outer covering is removed, and the remainder ground to flour or meal. It is a common practice to remove also the germ of wheat and of Indian corn before grinding to flour or meal, as the germ contains most of the grain "fat," and this readily turns rancid and might in time spoil the flour or meal if retained.

The most important cereal products are bread and macaroni, corn-bread and cakes, pastry, and other foods made from flour or meal.

THE BREAD FOODS.

Bread is a very old article of food. Primitive men pounded wild seeds, mixed the meal with water, and cooked the dough on hot stones. Loaves many centuries old, and blackened and charred by time, have been found in the bake-shops of the buried city of Pompeii, and even in ancient Egyptian tombs.

Throughout the middle ages, bread was the great staple food. If pewter plates or wooden trenches were lacking a thick slice from the loaf often served as a plate; and if the master did not care to eat the gravy-soaked bread, the servants who waited on him were only too glad to get it.

The nutritive value of bread depends not only on its chemical composition, but also upon its digestibility, and digestibility in its turn seems to depend a good deal on the lightness of the loaf. It is the gluten in a dough which gives it the power of stretching and rising as the gas from the yeast expands within it, and thus permits of its being made into a light loaf. Rye has less gluten than wheat, while barley, oats, and maize have none, so they do not make a light porous loaf like wheat, though they are much used—particularly corn—for making special types of bread or cakes.

It is possible that of the various kinds of wheat flour those containing a large part of the bran—entire-wheat and graham flours—furnish the body with more mineral matter than the fine white flour; but it is not certain that the extra amount of mineral matter furnished is of the same value as that from the interior portion of the grain. It has been shown by repeated experiments that, pound for pound, they do not yield more digestible protein than the white flours, as was once supposed. It seems safe to say that at usual

prices white flour yields somewhat more actual nourishment for a given amount of money, and contains the various food ingredients in as good proportions.

It must be remembered, however, that all kinds of bread are wholesome if of good quality, and that the use of several kinds in turn is an easy way of securing the variety in diet which is so desirable.

The raising or leavening of wheat and rye bread is usually brought about by letting the yeast plants develop in it. These minute plants feed upon sugar in the dough, and in their growth give off alcohol and carbon dioxide gas, which (particularly the carbon dioxide), expanding with the heat, force their way through the dough in all directions, and thus make it a porous cellular mass. In order to give the yeast a better chance to work, the dough is usually "set to rise" for some hours before it is put into the oven, for too much heat at first would kill the yeast-plant.

The lightness, sweetness and goodness of bread depend almost as much on the way in which it is made as on the materials used. The greatest care should be used in preparing and baking the dough, and in caring for and keeping the finished bread.

As compared with most meats and vegetables, bread has practically no waste, and is very completely digested. It is usually too poor in protein to be fittingly used as the sole article of diet, but when eaten with due quantities of other foods it is invaluable, and well deserves its title of "the staff of life."

OTHER VALUABLE CEREAL FOODS.

Considering all of its uses, corn is one of the most important of cereal foods from the standpoint of palatability, of nutritive value, and of digestibility. It may be prepared for the table in a great variety of ways, and in some form or other is deservedly used in the majority of American homes.

Oat meal and other crushed or whole grains are

very old food-products. In recent years, the manufacture of grain-foods known as cereal "breakfast-foods" has grown to be a great industry.

There is such a bewildering variety of cereal breakfast-foods on the market, with such differences in appearance, taste, and claims to nutritive value, that it often seems hard to make an intelligent choice among them.

Of the five cereals most commonly used for breakfast-foods, oats contain perhaps the largest quantities of the important nutrients, with a fairly low proportion of crude fiber or waste. Wheat ranks very close to oats in all respects, however, and even when prepared with the bran is freer from crude fiber. Corn and its preparations are rich in carbohydrates and fat, but are slightly less digestible than the other cereals. Rice is poor in protein, but remarkably free from crude fiber, and consequently furnishes a large proportion of digestible carbohydrates. Barley breakfast-foods contain a fair proportion of nutrients and are moderately digestible. All these differences in the composition and digestibility of breakfast-foods are comparatively slight, and may be disregarded by healthy persons living on the ordinary mixed diet.

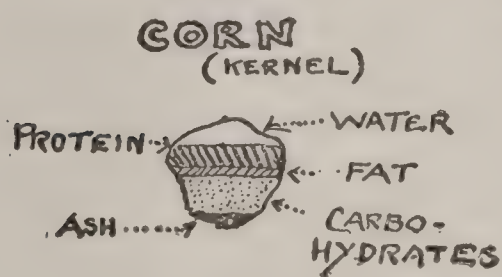
In choosing between the various breakfast-foods it must be remembered that a novel appearance and quasi-scientific name do not necessarily represent any unusual food value. Unless something is added during the process of manufacture, all brands must have just about the same composition as the cereals from which they are made, since manipulation can not increase the amount of food-material in a cereal product, though it may materially modify its appearance and flavor.

Thoroughness of cooking is a factor which has a bearing upon digestibility. It not only makes the cereals more palatable, but also breaks down the walls of indigestible cellulose (or woody substance) which surround the starch grains and other nutrients, and

produces other changes, by means of which the digestive juices can work on the nutritive ingredients more effectually. Poorly cooked breakfast-cereals are less palatable than the same dishes well cooked, and may cause indigestion and be really harmful. When the preparations partly cooked at the factory are used, care should be taken to insure sufficient re-cooking before serving. The majority of the ready-to-eat brands are apparently thoroughly cooked. All cereal foods are more easily digested if they are thoroughly chewed before swallowing.

VEGETABLES—GREEN AND DRY.

In a general survey of the world's food demand, wheat, corn, barley, rice and other grains rank prob-



ably as the most important vegetable foods; next in importance are roots rich in starch such as potatoes, sweet potatoes, and yams. Perhaps most often the term "vege-

table" brings to mind the various plants or plant parts which are used with such staple foods as cereals and their products, milk, butter, cheese, flour, sugar, and meat to make up the usual family dietary.

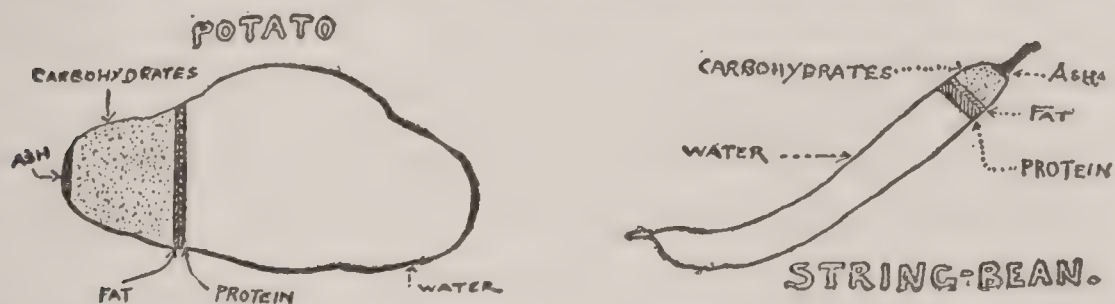
Under the general head of "vegetables" are included fruits, such as the tomato, squash, cucumber, melon, etc.; seeds and seed-pods such as green peas and string beans, cow peas, and green corn; seed-vessels, such as okra; flowers, flower heads or buds, such as cauliflower; lily petals which are eaten in China, and globe artichoke; (other edible flowers are told of elsewhere in this volume); leaves, such as lettuce, cabbage; and stems, such as celery, chard and asparagus; roots, such as sweet potatoes, turnips, salsify, and beet; underground root-stalks, such as potatoes and Jerusalem artichoke; and bulbs, such as onion and garlic.

Most of these vegetables are eaten fresh or green; some, like melons, are seldom cooked; others, like tomato, are commonly eaten both raw and cooked; while still others, like the turnip and beet, are almost always cooked in some way before they appear on the table.

Few vegetables are of such a nature that they can be eaten entire. The greater number contain more or less inedible material, such as seeds, skin, etc., which is ordinarily rejected when they are prepared as food, and referred to as "refuse." The proportion varies with different vegetables, constituting in the case of fresh beans and peas about 50 per cent (or one half), on an average, of the entire weight of the unshelled vegetable, and somewhat over 50 per cent, in the case of corn on the cob. When potatoes, carrots, parsnips, sweet potatoes and similar vegetables are peeled, the material removed constitutes on an average about 20 per cent (one-fifth) of the original weight.

VEGETABLES THAT ARE SEEDS.

Seeds used as vegetables and commonly marketed dry, such as beans and peas, contain little water and



have a correspondingly high nutritive value, and are directly comparable in composition and energy value with such staple food-products as the cereal grains. Especially important as vegetables are the seeds of a number of leguminous plants. The green or immature pea and bean are among the most palatable of green vegetables, and fully deserve the place they now hold on our bills of fare. The value of the dried pea, bean, cowpea, lentil and other "legumes" is such that one or more representatives of this class of foods are

found in every country as a staple food, and they have been thus used from the earliest times. The dry legumes are especially rich in protein, the nitrogenous constituent which forms the chief nutrient of meat, and are thus fitted to take, in part, the place of meat in the average dietary. Since, in comparison with their value, their price is low, they must be considered among vegetable foods as next in importance to bread.

Rightly prepared and well cooked, legumes are easily assimilated, and may be prepared for the table in many wholesome and palatable ways.

THE JUICY VEGETABLES.

Succulent or juicy green vegetables in general contain more water, and less nutritive material in proportion to their bulk. They are especially important because of the mineral matter they supply, and because they add so much to the attractiveness of the diet. What has been said of the green vegetables applies also to melons, tomatoes and other juicy fruit-vegetables. Their principal nutrients are carbohydrates, including starch, sugar and crude fiber, with varying amounts of protein, traces of fat, and an average amount of mineral matter which constitutes chiefly the salts of organic acids, phosphates and chlorides.

VALUE OF THE POTATO AND OTHER COMMON VEGETABLES.

No other succulent vegetables can compare with the potato and sweet potato as a staple in American homes. The large amount of carbohydrates these vegetables supply is an important source of energy in the diet. In the tropics such starchy roots as the true yam, taro and cassava take the place of the potato. Turnips, beets, carrots and other similar roots supply some carbohydrates as well as mineral matter, but owe their importance chiefly to the ease with which they can be cultivated, their good keeping qualities, and palatability. The onion, garlic and leek supply more or less nutritive material, and are conceded to be wholesome.

However, they are chiefly prized in the diet for their flavor. Mushrooms and other edible fungi, often said to be a sort of "vegetable meat," are really of low nutritive value though often very palatable. Pound for pound, they supply about as much carbohydrates as carrots, and supply little else.

Canned vegetables, which are such an important food product at the present time, differ little in nutritive value from similar vegetables freshly cooked. The same is true of dried and evaporated vegetables (now fairly common commercial products), after they have been soaked and prepared for the table.

Vegetables owe their characteristic flavors to the presence in them of acids, ethers, and similar substances. As is the case with other food products, cooking develops or modifies flavor, softens tissues, and renders starch and other nutrients more susceptible to the action of digestive juices. Furthermore, if long enough continued, it destroys any disease germs, and any parasites or their eggs which may be accidentally present. When vegetables and most other foods are cooked, the chief change is in the percentage of water present. Thus they may become drier if baked or fried, and more moist if boiled or stewed.

Although fresh vegetables contain such a high percentage of water they are nevertheless regarded as valuable articles of diet. Like fruits, or other bulky foods, they will furnish a considerable portion of the total nutrients of the daily diet if eaten in quantity, and this is particularly true of such vegetables as the potato, which is fairly rich in starch. When combined with more concentrated foods, particularly those rich in protein, such as eggs, meat, cheese, cereals, etc., vegetables contribute an important share toward a well-balanced diet.

VALUE OF FRUITS AND FRUIT PRODUCTS IN THE DIET.

Perhaps no group of vegetable food-products is more generally appreciated than the edible fruits.

These show the greatest range in flavor, form and appearance, and are found in almost countless varieties. From the botanist's standpoint, fruits are the seed-bearing portion of the plant. The edible fruits of the temperate regions may be divided into a few groups: stone fruits, such as plums and cherries; pome fruits, as apples, pears; grapes of numerous varieties; and berries, like blackberries, strawberries, and currants. Cantaloupes, muskmelons, water-melons, and some other such fruits are sometimes classed as fruit, and sometimes as vegetables, and of course would not be included in any one of these groups. The tropical fruits not so readily classified as those we have been considering, with which we are most familiar, oranges, lemons, etc., are members of the citrus family.

There are several vegetable products which are not fruits in any botanical sense, but which by common consent are grouped in this class, since their place in the diet is much the same. Rhubarb is the most common of these, and its acid stalk is used like fruit for making desserts, preserves, etc. Angelica stalks, which are candied and used in confectionery and in cakes are much less common than rhubarb. Candied ginger-root, and the old-fashioned candied sweet-flag, may also be mentioned.

Fruits, like leaves and flowers owe their varied color to a number of chemical compounds of definite character. Such is chlorophyl, which imparts a green color; zanthin bodies, which have a yellow color, while blue and red come from solutions in the cell sap of certain coloring matters which have not as yet been separated or carefully studied. In white fruits, coloring matter is absent from the skin parts, and the cells are filled with air.

As fruits develop, ripen and then decay, the coloring bodies present undergo decided chemical changes; and faded, dull coloring is often an indication of staleness.

The percentage of refuse, skin, pits, core, etc.,

varies considerably in fruits, being on an average of about one tenth of the total weight.

Fruits owe their chief nutritive value to the carbohydrates, (sugar of different sorts, starch, etc.) which they contain, though small amounts of protein, fat, and fair amounts of ash are also present in the ordinary varieties. Like the green vegetables, they are succulent foods; that is, the proportion of water present is high as compared with the total amount of food material.

It has been suggested that fruits containing 80 per cent or more of water be classed as "flavoring fruits," and those with less than 80 per cent as "food fruits." In such a classification strawberries, raspberries and blackberries would be included in the first class, and bananas and grapes and fresh figs in the second group.

Though most fruits have only a trace of fat, olives and avocado or alligator pear are remarkable for the large amount which they contain. In the case of the olive, the oil has been separated since earliest times, and used for culinary and medicinal purposes.

The principal carbohydrates present in fruits are cane-sugar, grape-sugar or glucose, and fruit-sugar or levulose, pectin, and more or less starch. Generally speaking, the stage of growth and the degree or ripeness have a marked effect on the kind and amount of sugar present, the riper fruit being as every one knows sweeter than the green fruit.

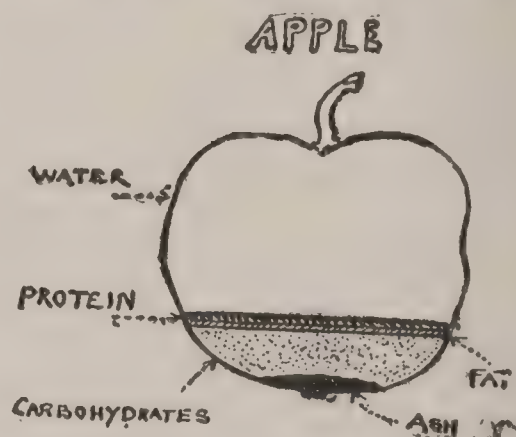
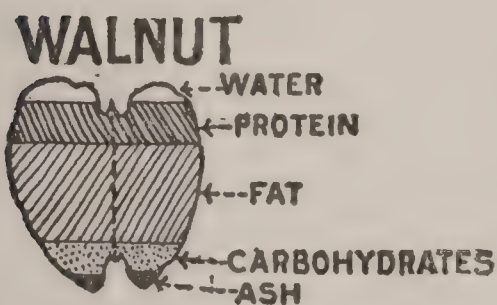
It is to the pectin bodies that so many fruits owe their jelly-making properties, since this starch-like material, when acid is present, has the property of taking up a large amount of water, and of gelatinizing it into solid form.

Dried fruits have been concentrated by evaporation, and so contain a much larger proportion of nutritive material pound for pound than fresh fruits. Some preserved fruits also have a comparatively high nutritive value, owing to the evaporation of water, the addition of sugar, or to both factors. Fruits, like

vegetables, owe their characteristic flavor to the presence in them of acids, oils, ethers and other chemical bodies of specific character.

FRUIT IN THE DIET.

It may be said in general that fruits, both fresh and preserved, are wholesome, palatable and attractive additions to the diet, and that they may readily be used to furnish a considerable part of the nutrients and energy which are required. The fresh fruits, since they are dilute foods, closely resemble green vegetables in the proportion of nutritive material they supply; but dried fruits, and many preserves, etc., are much more concentrated, and compare favorably with



cereals and other dried vegetable foods in the quantities of total nutrients and energy which they supply per pound. The characteristic chemical constituent of fruits are *carbohydrates*, and so fruits are naturally and rightly used in a well-balanced diet to supplement foods which are richer in *protein*, as legumes, cereals, grains, nuts, dairy products, eggs, meat and fish.

Fruits contain a fair amount of mineral matter, and so may be used to supply iron and other mineral constituents, without unduly increasing the total nutritive value of the diet. Because they are succulent, and perhaps for other reasons, fruits stimulate what might otherwise be a fairly sluggish intestine and help to clear out waste. It is universally conceded that they are wholesome articles of diet, though the special medi-

cinal virtues commonly ascribed to various fruits by early writers are no longer attributed to them by modern students of physiological chemistry.

NUTS AND WHAT THEY CONTAIN.

Nuts, both wild and cultivated, are important vegetable food-products, though the total quantity used is small as compared with such staple foods as cereal grains.

Botanically the term "nut" is not a definite one, but is applied indiscriminately to certain fruits, or parts of fruits, having a more or less hard, woody covering surrounding a meat kernel. The common nuts, such as walnuts, chestnuts, and beech-nuts are *fruits* of trees or bushes. The almond is the *pit* of a peach-like fruit. Some, which are eaten in large quantities, are obtained from pine-trees; some, like the coconut, from tropical palms; while others, like the peanut and pistachio, are obtained from leguminous plants, these two being respectively the fruit of a vine-like annual, and of a small tree.

As a whole, nuts are concentrated foods; that is, they have little water in proportion to their bulk. Most of them contain fairly large quantities of protein, amounting in some cases to about a third of the total weight. The percentage of fat in such nuts as the walnut and peanut is also high. Chestnuts differ from most nuts in that they contain large amounts of starch, a constituent which is lacking in most other common nuts.

Since the proportion of fat in nuts is generally high and the water low, it follows that, as a class, nuts have a high energy value.

Though nuts and nut products are very commonly eaten raw, they find many uses in cookery; as, for instance, the use of almonds in making various sorts of cakes, and the use of nuts of many kinds in candy-making.

Nuts have commonly been classed among the luxuries, but it is interesting to note that at the present time there is a tendency to use them as basic articles of diet and not as additions to an otherwise abundant meal. It is perhaps worth noting that they have been regarded in earlier times as staple foods, as is shown by the fact that they were regularly included in the ration of French soldiers in the Fifteenth Century.

If exposed to dampness, nuts mold and decay, and under favorable conditions, the oils and fats become rancid on long-continued storing. In the main, however, their keeping qualities are excellent. Nuts are not infrequently used as constituents of preserves, and within recent years the making of so-called "nut-butters" or pastes has developed into a large industry. Generally, the nut-butters are prepared by grinding the peanut or other nut and adding a little salt.

SEPARATED VEGETABLE FOODS.

Under the group "separated vegetable products," have been included oil, sugar, and other special products. Of these, olive oil and nut oil consist of pure fat; refined sugar of pure carbohydrates; and such materials as molasses and syrup consist of cane-sugar, with water, and more or less nitrogenous material, mineral matter, etc., retained from the plant juice.

Honey, a much prized food-product of vegetable origin, consists essentially of carbohydrate material, flavoring, a trace of acid, and more or less water. After the honey is gathered, it undergoes some change before it is deposited in the honey-comb, and is not exactly the same chemically as the plant nectar which the bee collected. Like molasses and syrups, honey owes its nutritive value to the sugars which it contains, and it is also prized for its characteristic and delicate flavor. Before sugar became so abundant, honey was the common sweetening substance in the diet.

Such products as maple-sugar, maple-syrup, and molasses contain carbohydrates as their principal nutritive constituent, together with varying amounts of water, a little protein, and relatively high amounts of ash. They are prized for their characteristic flavors, as well as for their nutritive value. The separated sugars, such as granulated sugar and pulverized sugar, consist of the pure crystallized cane-sugar in more or less fine or granulated form. The common source of sugar is sugar-cane and the sugar-beet, though it is present in many other fruit and vegetable juices. It has been often said that there is a difference in the sweetening power of cane and beet-sugar, but experiments do not bear out this belief, and from the chemist's standpoint they are identical.

Sugar, like starch, is an important energy-yielding constituent of the diet. Like other concentrated foods, it may if it is eaten in too great quantities, cause digestive disturbances; but this is due to its improper use, and not to the nature of the food material itself.

Separated starches are prepared from many plants for food purposes. Corn-starch, potato-starch, arrow-root and tapioca are perhaps the most common. The portion of the plant which yields the starch is usually crushed or ground in water to free the starch grains from the cells in which they were stored by the plant. The starch settles, and is collected and dried. In the case of tapioca, it is collected in the form of small globular masses; in other instances usually it is in the form of a powder.

Starch is a valuable source of energy in the diet, and convenient for use in the preparation of many dishes.

THE FRUIT AND VEGETABLE OILS.

Olive oil has been known since earliest times as an important food fat. When rightly made, and of good quality, it has a delicate nutty flavor. As it does not

contain nitrogenous material, it is not used in the body for building tissue, but solely as a source of energy, and, like other pure fats, has a high energy value, namely, 4,080 calories per pound. Nut oils are expressed in limited quantities from the beech-nut, walnut, and some other nuts for table or culinary purposes. They are similar in nutritive value to olive oil, though they possess characteristic flavors. It is interesting to note that the Indians separated oils from nuts and from sunflower seeds, for food and for other uses. Cotton-seed oil also has found extended use in the manufacture of lard compounds and lard substitutes.

All these culinary and table oils are used in a variety of ways as in the preparation of salads, etc. In the United States, olive oil is perhaps most commonly used in the preparation of salad-dressing. In other countries, as for instance Italy, Spain and Southern France, it is a common culinary fat, often taking the place of butter in many cooking processes. The use of oils of different kinds in such ways is increasing in the United States.

In this connection, mention should be made of cotton-seed oil, peanut oil, and corn oil, which are being manufactured for kitchen and table purposes in increased amounts, and are commonly conceded to be wholesome and palatable when of good quality.

ACIDS AND FLAVORINGS.

Vinegar, which contains a little extractive material and ash, in addition to 6 per cent of acetic acid and over 90 per cent of water, is a very old fruit product, and also one of the most common condiments and household preservatives.

Its use in the diet is in virtue of its flavor and other qualities rather than of the very small amount of nutritive material which it may contain. Honey vinegar, malt vinegar, etc., are well known, but vinegar

made from fruit-juice is far more common than these. Sometimes flavoring material, as the herb tarragon, is added in making special vinegars.

By fermentation, the sugar in the fruit-juice or other liquids is converted into acetic acid, and to this the vinegar largely owes its flavor, though the salts and other materials originally present in the fruit-juice, etc., go to the making of this vinegar. Vinegar made from apple-juice—that is, cider-vinegar—has always had a reputation for good quality, though other fruit-juices are of considerable importance in domestic vinegar-making, banana vinegar being one of the sorts which is well known in regions where this fruit is grown.

The acid juice of lemons and limes is used like vinegar as a condiment, and many consider that lemon-juice is more delicate. It is sometimes claimed that it is more wholesome also, but this seems hardly more than a matter of opinion, as there is no reason to suppose that the small amounts of vinegar ordinarily used are in any way harmful to the average person.

Verjuice, the expressed acid juice of green apples, crab-apples, or other unripe fruit, was formerly used as a condiment and was much prized. Its use has survived to the present time in a limited way, and it may occasionally serve a useful purpose in cooking when lemon-juice is not readily obtainable.

The bottling of grape-juice and other fresh fruit-juices, (like canning and preserving)—once done in the home, has assumed large proportions as a commercial industry. The fresh juices are heated to sterilize them, and sealed to prevent the access of air and of the micro-organisms which it would almost certainly carry with it, as these would cause the juice to “spoil” or ferment. Such unfermented fruit juices are wholesome and palatable and find many uses in the diet. They are dilute foods, as the proportion of water in them is high, the chief nutritive material being sugar.

THE PREPARATION OF VEGETABLE FOODS FOR THE TABLE.

Such vegetable foods as cereals and cereal products, dry legumes, and ripe seeds of all sorts, many roots and other vegetables, and some fruits, are generally cooked before they are eaten. Others, chiefly salad plants and fruits, nuts and some vegetables, are commonly used raw; while still others, chiefly root vegetables, green vegetables, and fruits, are used in both ways.

All the ordinary cooking processes are employed in the preparation of vegetable foods. Thus cereals are parched (as in the case of some cereal breakfast-foods), baked (as in bread), or boiled (as in the case of rice). Root vegetables and tubers are boiled, baked, fried, or prepared in other ways; while green vegetables, fruits and other plant products are baked, or used in made dishes in countless ways.

Whatever the method of preparation, it is absolutely essential for health and safety that the food should be clean, wholesome and of good quality. The character of our food-supply, both animal and vegetable, is safe-guarded by National, State, and Municipal laws and regulations, which provide for inspection as to quality, and fix standards as to purity, cleanliness, and wholesomeness.

THE PRESERVATION OF VEGETABLE FOODS.

In earliest times man learned to preserve, for future needs, any excess of food, which he had happened to procure, by such methods as drying, freezing, or smoking. Methods of food preservation of the greatest importance at the present time are only modifications of these old processes. The treatment with salt is also an early method of food preservation which is still of great value. A great advance was made when it was discovered that foods could be kept in good condition for a long time by heating them in sealed containers, and the whole matter of food preservation was finally put on a scientific basis when it was found

that decay is due to ferments, to bacteria and other minute forms of life which are responsible for the processes known as "decomposition."

In earlier times the available food supply was very largely determined as to variety by season or by climate; thus, in northern regions, cereal foods, roots of good keeping quality, like potatoes and beets, and fresh meats were the common winter foods, while salt meats and a much more abundant vegetable and fruit supply characterized the summer diet. Improved methods of preserving foods and improved methods of transportation have made a great change in this respect, and today the diet of the family of moderate circumstances is much more varied throughout the year than that of the man of wealth even fifty years ago; while many fruits and vegetables, which were luxuries or were obtainable only for a short season in summer, are now common throughout the year.

It would be interesting to consider in detail the methods followed in growing grains, vegetables, fruits and other food crops, but this is a subject so important that it merits independent treatment.

The raising of crops of all sorts, which was formerly a matter of experience or "rule of thumb" is now an industry which rests firmly on a basis of fact established by careful experiment. This may be said also of milling and baking and other important food-manufacturing projects.

Doubtless no one can say how many persons are engaged in raising, marketing, manufacturing and selling the great variety of vegetable products used as food, or in preparing and serving them, and no figures are available which show completely the money value of all these food activities. It is safe to say that both as regards the numbers engaged in it, and the capital it represents, the food industry as a whole (which comprises all that pertains to the production and use of both animal and vegetable foods) is the greatest industry in the world.

CHAPTER X.

Juices and Extracts from Plants.

HE earliest men probably drank only water, and did not need any drink except that, until they had ceased to live mainly upon fruits and begun to eat meat and fish. It is believed that it was the eating of meat especially which first caused the craving for something stronger than water. Undoubtedly, men soon learned to drink the milk of animals, and it is likely that the very first stronger drink came from having drunk stale milk, for it is well known that mare's milk will ferment and produce a drink that is even slightly intoxicating. Kumyss, or this fermented milk, has been drunk by the Tartars for ages. While the cow's milk is most generally chosen, and is the mildest, that of mares, camels, asses, reindeer, and goats is greatly enjoyed and preferred by many races.

The ordinary drinks are to be divided into three classes: those that merely satisfy thirst and please the taste, those which are also exciting and irritating, or even affect the mind, and, thirdly, those that are soothing and nutritious. If we take the order in which drinks are ranked according to their popularity among all mankind, undoubtedly we shall give first place to milk, and, second, to the vegetable drinks, cocoa, chocolate, tea, and coffee, of which cocoa is by far the oldest. Of these, coffee is the one most used, it having been calculated that some five millions of people drink coffee daily; while only one-fifth as many take tea, and only a little more than a tenth part use cocoa or chocolate. Strangely enough, these three drinks, while they differ greatly in flavor, depend upon very much the same chemicals for pleasing the taste.

DRINKS FROM PLANTS.

These range from pure water to the most intoxicating liquors and strongest drugs, and there is hardly a kind of drink which is not easily prepared from some vegetable growth. Pure water is found both in the hollow stems of bamboos, and also in certain climbing vines in South America, in the "traveler's palm," and in the cactus plant, the latter sometimes holding enormous quantities, cool, and ready for drinking, though the plant itself springs out of sandy deserts, where no water can be seen for miles around. The watermelon also furnishes a juice that is but little flavored and completely relieves thirst. Another fruit where the juice makes up almost the entire pulp is the "caju," the fruit of the caju or cashew-tree, and apple, grape, and pear juice are practically little more than flavored water, if they have not been fermented.

When these ferment (an action which is caused by the growth in them of a microscopic plant), a gas is produced that gives the sharp taste to cider and other such liquors, and also helps to relieve thirst by slightly deadening the nerves of the tongue, so that one need not drink so much in order to relieve the sense of dryness in the mouth. In making these fermented liquors, ciders and wines are produced from fruit-juices, and beers and malted liquors from seeds or grains. Malt, barley, and many other grains, even peanuts, are used for beer-making, and we may say, briefly, that nearly every fruit or seed can be used to produce a liquor, and many of these are drunk by different races. Plant juices, when fermented, make an alcohol, and thereby produce the drinks known as spirituous liquors. Rum comes from sugar-juice, gin from juniper, brandy from grape-juice, whiskey from corn and other things, and "pulque," very popular in the Southwest, is the fermented juice of the century plant, even one plant producing a very large quantity.

We can not attempt to give a list of the many alcoholic drinks, but the effect of all is much the same upon the system, only depending upon the amount of alcohol in them. When this is present to the amount of one-third, or more, a very strong and intoxicating drink is made, the bad effects of which are well known, and the good effects of which are more and more doubted every day by physicians. Most harmful drinks are harmful simply because they are made too strong. Thus caffeine, like some other vegetable substances, is comparatively harmless when in weak solution, but when, in large quantities, it enters into drugs, these become far more harmful to the heart and the brain than even the alcoholic drinks. All strong drinks do most harm by their after effects. They whip and stimulate the system to intense action and exhaustion, or wear, results.

Caffeine is found in many plants to a greater or less degree, and a drug much like it is found in a weak and harmless state in chocolate and cocoa. It may be stated as a general rule that where drinks are made from vegetable products, they contain either alcohol, caffeine, or some similar substance, and are drunk for the slightly stimulating effect on the system. Thus, in the Southern Pacific islands there is made from the black-pepper plant a drink called *kava*, and from Indian hemp is made the powerful drug, or drink, *hasheesh*, whose use to excess results at length in a pitiable state of terror, and sometimes even in madness. In the southwestern United States drinks are made from the cactus plant which have somewhat similar effects to those already described, differing widely according to the particular cactus used. From the poppy is extracted a juice that gives the gum, opium, a drug, the effects of which seem to differ widely according to their use. Nearly all of our best sleep-producing medicines are made from it, and its quality of deadening pain, when used by physicians

and for a right reason, may certainly be considered a blessing to mankind. But the smoking of opium, and its use to excess, result in complete ruin, especially when taken up by other than Orientals. No doubt many eastern races suffer exceedingly from over-use of opium in some of its forms, but in order to be fair, we must regard the opinion of medical men who have asserted that there are benefits in the use of opium.

THE CACTUS.

In nothing is the cactus more useful to mankind than in its use as a storer-up of water, in which it resembles the watermelon. The sap of the cactus is also found to be a beneficial addition to water, making it a drink good for the health. From the juice of the cactus agave, is brewed *pulque* and *mescal*, which have become the national drinks of Mexico; indeed the Mexicans get not only drink, but food and clothing from the cactus. The southwestern part of the United States, where there are so many sandy, arid plains, brings forth countless varieties of the plant. They are of all sizes up to twenty feet or more, the height reached by the century plant, which does not, however, pass a hundred years before blooming, as is popularly supposed, the true period being ten or twelve. The yucca may reach forty feet in height.

The cactus plant has been compared to the palm tree in its general usefulness to the people of the region where it grows. Every part is used. The fibers are used for weaving, the substance of the plant can be eaten, its juice makes a drink, and the exquisite flowers found in some varieties, as well as the strange forms into which the plant may be trained, cause it to be greatly valued for ornamental purposes. They are abundant in the parks of the west, and at seaside resorts.

The century plant, or agave, is one of the most useful. The sap, abundant when the plant is about to

flower, is fermented to make pulque, an extract from the leaves takes the place of soap, and the weathered flower-stem is hard enough to form a hone, or strop, for razors or tools. From the leaves comes a fiber to be used as thread, to make into paper, or to form ropes. Sisal hemp comes from a species of this plant. It bears a green fruit having a crimson pulp, which can be preserved. The Indian fig, or prickly pear, is also a well known cactus, which, besides being used as a hedge plant, bears juicy and eatable berries. Some species are used in raising the cochineal insect, as they feed upon this plant, and for the valuable dye extracted from the insects we have therefore partly to thank this cactus.

COCOA AND CHOCOLATE.

Both of these names are applied to preparations made from the same plant, a native of America, growing in regions too warm for frost. When the Spaniards first entered Mexico, they found that cocoa-seeds were so generally used, and so valued, that they passed from hand to hand like money. It was introduced by the Spaniards, about the middle of the sixteenth century, into Europe, and has more recently been raised in British India. The Latin word, *theobroma*, comes from two Greek words, and means "food of the gods." The ordinary name, cocoa, is supposed to be taken from the Portuguese word, "macoco," a monkey, because the end of the fruit looks somewhat like a monkey's face.

The word "chocolate" was thought to be simply "choco-lait," or cocoa-milk, a name given it by a doctor in an early account; but it is more likely to have come from the original Mexican name, *chocolatl*. An early writer tells us of its nutritive quality, stating that the famous Cardinal Richelieu derived health and strength from its use. In England it has been used since about the middle of the seventeenth century.

The ancient Mexicans seem to have flavored it with vanilla, as is done today, and also with other spices. Besides containing fatty substances, starch, and sugar, it also has a small quantity of the drug, theobromine, as already mentioned, and this chemical makes it, though to a less degree, stimulating to the nerves, as are tea and coffee. The natives of the countries where it grows eat the fresh pulp, but the most important commercial part of the plant is the seed and its vessel, which provides the drink and the food that is so popular throughout the world, especially in more southern climates.

It is probable that chocolate might have become as popular as tea and coffee, except that for many years Spain owned the trade and kept it in her own control, charging a very high price for the product, so that only the rich could afford to enjoy it. Indeed, its making was for a long time kept secret.

The cocoa-tree grows in Ecuador, to a height of twenty to thirty feet, though usually not so tall. The seeds are in a long pod, dark yellow in color, hard, and from eight to fifteen inches long. The seeds, when roasted, can be separated from their harder shells, and from these shells a wholesome and cheap drink can be made. Cocoa-nibs are formed from the coarsely ground part of the seeds, and the more finely pulverized part is made into better cocoa by removing a small part of the "cocoa-butter," or fatty portion. To make chocolate, the fragments of seeds are ground fine, and less of the fat is removed. Sugar is added to make the sweet chocolate, and various flavors can be used, vanilla, from the vanilla bean, being the most popular. The cocoa-butter, or fat, is used in candy-making, and by druggists as a pure base for ointments and pomades.

It is doubtful whether chocolate or cocoa will ever become so generally used as tea and coffee, perhaps for the reason that they are foods as well as drinks,

and we know that the appetite tires of any one food, especially if it have a marked flavor. Little except the flavoring portion of tea and coffee is left in the water, but in the case of cocoa the entire substance is dissolved, or contained in the water or milk, which makes it a much heartier drink.

TEA AND COFFEE.

The coffee-plant bears its berries wherever there is no frost, and the chief regions from which it comes are in South America and the East Indies. It was probably carried from Persia into Arabia nearly five centuries ago, and was first used as a medicine. About the middle of the sixteenth century it became an article of commerce, first in Constantinople. Here its use was forbidden by the priests, since the people thronged the coffee-houses and deserted the mosques. Then its sale was forbidden by law, and the police tried to suppress it. When it was found that the sale could not be stopped, the State put a tax upon it and raised a large revenue. It has constantly grown in popularity, being used throughout the world, especially in Turkey, where it is drunk constantly and stronger than anywhere else. At one time it was a legal cause for divorce if a man refused to furnish his wife with coffee.

The Dutch, having procured berries from Mocha, planted them in one of their colonies in Batavia, and sent a plant to Amsterdam, from which others were raised under glass, and sent to parts of the East Indies. The Dutch also made a present of a few plants to Louis XIV of France, and from these were raised the coffee-trees for the French West Indies. It was thus that the plant came to America, and spread from the West India Islands to South America.

An interesting story is told of the first coffee-plant exported to Martinique. It was under the care of a French cavalry officer, who kept it alive even when

the water supply aboard ship ran low, going thirsty himself for the sake of the plant. From so small a beginning has come the enormous coffee-trade of Brazil, Mexico, and the West Indies, which now produce as much coffee as Java and Ceylon.

The drinking of coffee was introduced first in Venice, by merchants who procured the berries from the East, and it soon spread into Italy and, through Marseilles, into France. Though the first café, or coffee-house was opened in Paris in 1671, it was not until the beverage was served in a very elaborate and fashionable style that it became truly popular. The plant itself is from eight to eighteen feet high, but is usually kept low enough to make the gathering of the cherry-like berries convenient. Each berry contains two seeds, which must be freed from the pulp and the stiff covering before they are used. As is well known, the seeds are roasted and ground, or pounded, so that when hot water is applied the oils and essences will be extracted. The chemical that gives coffee its value is the same that is found in tea, but there is only half as much in the same quantity of berries. The effect upon the nerves and circulation are similar to that produced by tea. If made with equal strength, that is, using as much tea as coffee, tea would be much the stronger beverage.

The coffee-leaf contains more of the essential oils than the berries, but has not the flavor or aroma. Since both can not be taken from the same plant, the berries are preferred.

It is impossible to lay down rules as to whether either coffee or tea is harmful or beneficial for any given person. The modern science of diet declares that it is not easy to give general rules for such matters, as so much depends upon the person in question. It is not difficult, however, for each one to know for himself whether he is using a drink to excess, and to be guided by his own experience. Much depends upon

the age and habits of the drinker. It would seem that coffee would not be so generally used unless it was found agreeable and wholesome by most people. And the fact that tea seems to be the preferred drink in England by those who are able to have either, would show that there is in the climate of different lands something affecting the taste for these beverages.

The Dutch are the greatest coffee drinkers, and the Belgians and Danes come next, then, in order, the Norwegians, Americans, Swiss and Swedes, all of whom drink enormously more coffee than do the English. America's coffee-drinking requires eight pounds a year for every man, woman, and child, while in Holland the average is twenty-one pounds for each person. The Turks also, as has been said, are great consumers of coffee; and yet the Dutch and the Turks are among the least nervous persons in the world. It is difficult to see any good reason why countries so near one another as Holland and Great Britain should differ so enormously in their choice between these two beverages.

Tea differs mainly from coffee in that it is made from an infusion of the leaves. It is thought to have come first from China, but is now widely cultivated throughout Asia, especially in India. The plant needs a warm, moist climate, with few changes of temperature, and a fair amount of rainfall. It is believed that it could be cultivated much more widely than at present. The origin of the name is not known, but the leaves have been an article of trade for more than fifteen hundred years. It was not until the seventeenth century that it appeared in Europe, though some time before that a present of tea was made to a Russian Embassy in China, who received it most unwillingly! The Great East India Tea Company, no longer ago than 1664, presented two pounds of tea to the Queen of England, and the present was estimated to be worth something over twenty-five dollars

a pound. It was not until the nineteenth century that it became plentiful enough to be in common use, for it was at first enormously expensive, and sold only by druggists. Black tea is made from leaves that have been exposed to the air; green tea from those not so exposed. Both are roasted, rolled, and dried.

Like most new things, tea, when first introduced was accused of causing a number of diseases, but it steadily grew in favor, and is now drunk daily by more than six hundred millions of people. China uses the most, Great Britain next; Americans drink only about one third as much as the British, and the Russians half as much as the Americans. But these figures are probably affected by the wealth of the people. There are, no doubt, in America and England far more who can afford to drink tea in large quantities. The plant is raised from seed, then reset, when it is six or eight inches high, in a nursery, where it is kept for nearly a year before being planted outdoors. Women and children pick the leaves and end-buds, which are spread on mats, roasted in pans, rolled in the hands and finally dried over a charcoal fire, though not all tea is prepared in the same way. There is a great difference between the best and the worst qualities of tea, and some men make a business of judging it.

It is amusing to read that warnings against the use of tea compared it in its effects to opium and other harmful drugs, and accused it of being the cause of drunkenness. Jonas Hanway, well known as the first man to carry an umbrella in London, wrote in 1756: "Men seem to have lost their stature and comeliness, and women their beauty. . . . What Shakespeare ascribes to the concealment of love is in this age more frequently occasioned by the use of tea." But the new drink won many friends among poets and scholars, and Doctor Johnson describes himself as "a hardened and shameless tea-drinker, who for twenty years diluted his meals with only the infusion of this fasci-

nating plant; whose kettle had scarcely time to cool; who with tea amused the evening, with tea solaced the midnight, and with tea saluted the morning.”

It would seem that the drink must have many good qualities, supplying the system with water in a palatable form, nutrition in the sugar and milk, and the same stimulation that is found in coffee and several other drinks less widely used. In the absence of its abuse, it does not seem to be followed by any reaction; and we may conclude, as before in the case of coffee, that the moderate use of tea, when rightly made, does much good and little harm. Very careful and interesting accounts of tea-drinking are found, under the heading “Tea,” in all general works of reference, for the story is well known, and presents many amusing and interesting phases. It is said that the very best qualities of tea would lose their flavor if transported too far, and that they are therefore never tasted outside of China and Russia. Of late years Ceylon and India have been growing in importance as sources for tea.

The first American tea-plant was planted, in 1800, in South Carolina, and was still living a few years ago. Not much has been done to raise tea in this country, but there is nothing to show it is not possible in the southern portion, if artificial irrigation is used to supply the lack of enough rainfall. There are a number of substitutes for tea used to make drinks somewhat resembling it. Most of them are known by the same name, with an adjective prefixed, as Chilian tea, Trinidad tea, Labrador tea. It is remarkable that the three chief beverages came into Great Britain within a very few years. Cocoa came by way of Spain from Siam, coffee next, and tea last of all.

CHAPTER XI.

Mushrooms, Flowers and Sea Weeds as Food.

MUSHROOMS.

HOUGH the chief part of our food comes from the highest kingdoms of animals and vegetables, yet men have learned that some of the lowest plants have a high food value. This is so different from what one might expect, that many people are inclined to exaggerate this value, and attach too much importance to such foods as mushrooms and mosses, for example.

The appearance of mushrooms, after the occurrence of damp weather especially, is so magical, their growth is so fast, and their life so short, that it seems as if they fell from the air. But study has shown that the part of edible mushrooms which we cook, or eat raw, is no more than the spore-bearing part that rises above the ground when the plant is ready to renew itself. Beneath the surface will be found long threadlike roots, if we may so call them. These extend widely, ready to send up the surface plant very quickly whenever there is enough moisture to build up the structure that is mainly cells filled with water. The dropping of the spores, or seed part, takes place usually from the under side of the umbrella-like top, and from these seeds new thread-like roots extend until another crop is ready to appear.

We have said that people greatly exaggerate the food value of mushrooms. If we judge by what chemistry teaches, we shall find little more in them than is found in the juicy leaves of cabbages; and when we consider the cost of mushrooms, we shall find it far to exceed that of meat, and still more greatly to exceed the cost of flour. They have, however, a

great value because of their flavor. This matter of flavor of food has, of late years, been found to be of the greatest importance to ourselves and to animals. The digestive organs act best and most effectively when food is such as to please the taste. In this way mushrooms are a delicious and useful food.

Most unfortunately, among the many varieties there are a few which are either fatally poisonous or very harmful, and, to put the matter shortly, we may say that only careful, well-informed students are able to tell the harmful from the useful varieties that are so like them. Although it is not safe to rely upon any one sign in deciding that a mushroom is harmless, yet there is one sign that is a certain proof of danger. The most dangerous species of all, the amanita, has at the base of its stem a sort of cup from the bottom of which the stem springs. This is also found in other dangerous species. If all mushrooms having this cup are rejected, you will at least be warned against the most dangerous, and will lose few or none of the good varieties.

There are also a number of species that may cause sickness, even if not so deadly as the amanita, and these also must be avoided; so we see that the only safe course is to follow the guidance of one who knows accurately the good from the bad.

What we have said applies mainly to the forms of mushrooms that grow up with a stalk and an outspread top. There are many varieties in which this form is not followed. Some are like irregular shells, such as may often be seen growing from the surface of trees or fallen logs. Some are like coral, branching out in a tree or sponge form; some are mere cups, or round puffballs.

It should be carefully noted that there are no easy and simple rules by which to tell the good from the harmful. It is not true, for example, that the poisonous varieties will turn a silver spoon black if it is

put into them while cooking. Neither is it true that only these will curdle milk. It is to be said, however, that none of the mushrooms should ever be eaten except when they are fresh, and the slightest decay, or blackening, is a signal that the plant is best avoided. Neither taste nor smell is a safe guide, nor can we say that it is safe to eat mushrooms that are eaten by insects or other creatures. From this you will conclude that it is not wise to eat mushrooms until you have become so learned about them that you know all the methods by which botanists and experts can tell one kind from another. Those that are sold in stores, whether fresh or canned, are usually such as have been raised artificially, for mushroom culture has become a business carried on by preparing the right kind of soil in cellars or caves, sowing the spores, and raising regular crops.

FLOWERS AS FOOD.

A number of flowers valuable for beauty and perfume are also edible, though chiefly liked because of their flavor. One we all know is made by adding sugar to the petals of violets, and a similar use turns carnations, the lavender, the syringa, the lilac petals and rose leaves into dainty preserves. An orange candy can be made by picking the tiny bitter orange from the blossom's center. The flowers of the orange-tree, boiled down with sugar or with water, give either a delicious orange-flower water, or a syrup that stirred into ice water or poured over batter cakes is much relished. Drinks can be flavored with syrups made from many of the flowers mentioned, and the violet sherbet is much drunk in the East.

Another flower often eaten is the nasturtium, especially valuable because of the bitter flavor of its leaves and stems. These may be used as a salad, or to add a pleasing flavor to sauces and gravies. The spearmint is favored in England as a flavoring much as

nasturtium is with us. And the English housewife also prepares a cowslip wine, flavored with various leaves and herbs and sweetened with honey or sugar. In many places the soft parts of thistles are found to be nutritious and are eaten, not only by animals, but by men.

We have spoken of those flower foods that are best known, but the list would be enormously extended if we were to add the many more unusual plants which various Indian tribes have found edible. Thus some natives make a soup from budding cattails, and the Delaware Indians, it is said, used to cook the young shoots of the milkweed that bears an orange-colored flower. Other tribes eat the clover blossoms. The Japanese eat some species of chrysanthemums, chopped fine and served with a cream sauce.

We do not often think of the cauliflower as a true flower, yet the part that we eat is the unexpanded flowers of a variety of cabbage. So we see that Doctor Johnson was not entirely incorrect in calling this "the finest flower in the garden."

These facts are taken from an unsigned article in the *New York Sun*, dealing with various unusual foods, and the author tells us that our flower, the dahlia, was first introduced into Europe with the idea that its root, like that of the potato plant, would be eaten. As a food it had no success, but the flowers were exceedingly popular, have been widely cultivated, and much changed by the care of gardeners. The sunflower is well known to bear a large number of very nutritious seeds, good eating both for mankind and for animals. It is said to be used to make a bread for Russian soldiers. Lilies are eaten in China, and are a valuable article of export. The flowers are eaten cooked as a vegetable, or are dried and made into a seasoning. In the East also a tree named the mhowad bears a flower so sweet that it needs no addition of sugar, and is excellent to eat with rice. When dried

and turned to a flour these same blossoms can be baked into a bread, and from them also can be prepared a wine and a strong spirituous liquor. Other flowers sometimes eaten are those of a ginger plant, a species of rhododendron, and those of the pagoda-tree of India. In telling of the spices we have mentioned the caper, the clove, and other edible flower buds.

To complete the list of all edible flowers would require a study of the foods of all nations, but we have mentioned the most important. At times it is the pollen of the flower that is relished, an example of which is that of the sago palm and of a species of reed in New Zealand.

SOME OF THE EDIBLE SEaweEDS.

In the books, the name under which seaweed is described is *algæ*, and there are quite a number of these plants which are eaten in various parts of the world. Thus there is a red seaweed known to the Scotch and the Irish, and formerly cried about the streets of Edinburgh, under the name “dulse.” In Ireland the same seaweed is known as “dillesk.” There is another seaweed eaten by the Irish people which abounds near the town of Waterford, but is common on many coasts of Great Britain and Ireland, where it is found upon the rocks and stones. While growing, it is a brownish purple and very tough. Upon drying it in the sun it becomes whitish purple. By soaking it in water afterwards, the nutritious part of it can be extracted, when it is used for giving body or thickening to soups, in preparing foods like blanc mange, and in other ways. This latter kind is often known as Irish moss, or as “carrageen.” In the north of Europe an edible seaweed is known as tangle, and this, too, used to be sold by peddlers in the streets of cities.

The name moss is applied to some other species also because of their resemblance to land moss. Thus we have the Ceylon moss, much used in the island of

that name and in neighboring countries, but especially by the Chinese, who, owing to the poverty of many of the people, have found out and make use of nearly everything that can afford them food. Seaweeds are eaten in Corsica, and, indeed, in nearly all seacoast countries.

Besides its direct value as a food, there are many kinds of seaweed which are collected to serve as fertilizers upon farms, or for bedding in stables. The name "kelp" is often given to any kind of seaweeds used in fertilizing, and also to the substance produced by burning them. This contains chemicals formerly used in glass-making, and in making soap, and also furnishes iodine.

PART II—Continued.

Section 2.—Materials from Plants.

CHAPTER XII.

Woods.

E shall get the quickest idea of how many purposes are served by wood if we take an example that will in one plant combine the widest variety of useful products. There are several trees which are so generally useful to mankind that it has been said that, alone, it can furnish nearly everything necessary, not only for life, but for comfort. These are the bamboo, the coconut, and some of the other palm-trees.

WOOD AS A SOIL MAKER AND AS FUEL.

But before considering the more special uses of wood, we ought to remember its use in forming soil and as fuel. One may say that these two uses are the same, for in order that wood should, when dead, crumble up, rot, and go to the making of soil that can support other plants, it must go through the process of slow oxidizing, and oxidizing is only another name—a chemist's name—for burning. If the oxygen in the air can combine rapidly enough, then the combining is called burning, and results in separating the wood into carbon, or charcoal, and various gases. If the wood is not heated, then the combining is very slow, but equally breaks up the particles of wood into the same gases and the same carbon, or charcoal, so that other plants may be able to feed upon it. In this way

we see that all plants depend for their life upon the remains of others, and thus we owe all vegetable life to the breaking down of that which has gone before it. The use of wood for fuel began far beyond any time of which we know, and lasted until the discovery that coal would burn, and this discovery is really a very recent one.

To wood as fuel we owe cookery, which not only makes food better to eat, but helps us to preserve it; we owe the warmth without which our ancestors could not have lived long in any except the mildest climates; and we also owe to fire preservation from wild beasts, who will not cross a barrier of flame. All through the ages, even to our own times, men's night camps have been made safe by rings of fire. The entrance to their cave dwellings have been guarded in the same way, and prowling beasts have by fire alone been prevented from attacking villages or camps too weak to resist them.

WHAT WOOD AS FUEL HAS GIVEN US.

Of course we can not imagine what might have been without the use of fire, for, so far as we know, the life of mankind is entirely dependent upon it everywhere except in a few highly favored regions. But in thinking what we owe to fire it will not do to leave out all those metals and minerals which, by the use of intense heat, are separated from the other things with which they occur in nature, and by heating are made into forms adapted to every purpose. While some metals can be roughly pounded into shape, and are found pure enough to be so used, iron, the most useful of all, has to be separated from the ore by melting, is formed, or hardened, only by fire, and the same thing is true of all except the rudest kinds of pottery. Some clays may be baked in the sun so as to stand careful use, but only firing gives us the hard, durable vessels that will hold food safely, can be used for cooking, and save by breakage are nearly indestructible. Glass also is a gift

from fire, and mankind, from the beginning, has found all high civilization or development impossible without the use of this marvelous servant—until the finding of electricity, by far the most useful of all **man's** discoveries.

In a book by George Iles, *Flame, Electricity, and the Camera*, he tells us what this servant has been to mankind, and how it enabled the savage to create nearly all the comforts and safeguards that have come to surround and delight civilized peoples. While electricity carries us further along the same road, yet fire, which meant the getting, shaping, and using of metals, and materials, had done so much for us that electricity rather added to our luxuries than served our needs.

And it is to the use of woods as fuel that we owe the earliest mastery over metals, earths, and other minerals.

WOOD MADE MANKIND SAILORS.

Perhaps next to the use of wood for fuel should be ranked its use for rafts and boats. Only the very narrow streams and inlets could be crossed by wading and swimming, but as soon as man was clever enough to guide a floating log, or to fasten a few together to make a raft, he was able to wander far afield. When man had thus learned the ease of traveling and carrying burdens upon the water, the rivers became, not only the first highways, but the most important means of transporting goods. Anything that was near the head waters of a stream could be transported without labor, except the little trouble needed in guiding the raft for many miles upon the rivers that were not too much interrupted by falls.

Once embarked upon the water, men began to improve their craft, and the means of guiding and propelling them. From log to hollow dugout, thence to the canoe, and from canoe to sailboat, progress was rapid and led by a sure road to the enormous steamers nine hundred feet long that now cross the ocean. But

the beginning of all this man owed to the fact that wood was light enough to float, and yet was tough, and would bear long soaking in the water. These qualities are shared more or less by every sort of wood, but when we see the vast differences between the woods that grow throughout the world, we shall find it difficult to name any need of mankind which is not served by some form of this marvelous material.

In order to see how important wood was in the past, we need go no further back than to the early days of the United States or Canada, for the people had to live in those times as simply as their ancestors had done hundreds of years before in Europe.

They could bring little with them across the ocean, and for long years found metals of every sort too expensive for common use.

WHAT WOOD WAS TO OUR FOREFATHERS.

In our own times, when metal is both cheap and easily worked, it is hard for us to imagine how much more wood was used in old times, and even down to a period as recent as Colonial days, and in foreign countries when they too were less civilized. Scores of articles useful on the farm and in the house then came from the forests or the wood-lot. Much of the time now given by young people to reading, was then used in manufacturing with the pocket-knife, or a few, simple tools, articles for their own household, or for sale. Out of the birch-tree, besides the many articles mentioned in another part of this volume, were made excellent brooms, part of the wood being left for a handle, and the rest being split up in fine fibers to form the brush part. Even plows and harrows, cart wheels, and such heavy articles, were cut from tough wood, and all sorts of vessels for holding liquids were made either by hollowing out pieces, or by fastening flat pieces together, as in our wooden pails. Children of course had their popguns from the elder bush, their whistles

of willow, and bows and arrows from many springy woods besides hemlock and hickory. Scythe, axe, and hammer handles, oxyokes, sled-runners, bean-poles and stakes, are among the things for which the Colonists depended upon the forests. Their first dishes were square or round trenches, hollowed out, and larger hollowed pieces were burned or scraped from sections of a log to make mortars, troughs, and great bowls. All the little implements used in the kitchen for forming cheese and butter, for churning, tool-handles, flails—were of wood, and the Colonial farmers needed little metal except for axes, knives, and fire-arms. The doors were latched with wood, wooden buttons fastened doors and windows, even clocks were cut from close-grained maple and similar woods, needing only a little metal for pins and so on. Shoes were fastened together with wooden pegs, the houses were largely formed of shingles, even hinges strong enough to carry heavy doors could be made from the tough hornbeam tree. Cups and bowls came from the maplewood, and lasted for long years. Spinning wheels, shuttles, and swifts were often made without more than a metal pin or two, used as axles.

Alice Morse Earle, in her *Home Life in Colonial Days*, tells these things and gives a much fuller account of the ways in which people of old times were dependent upon wood for home comforts, and points out how Thomas Tusser, the old English author, gives poetical advice to the English of the sixteenth century in regard to the best kinds of wood to use for various farming necessities, and it is from these same English ancestors that the American had learned which woods were best for special use.

THE YANKEE A "WHITTLE."

In older English a knife was called a "whittle," and it is so called even in Shakespeare's plays; from this is derived the verb "to whittle."

So busy were the early Yankees with their jack-knife industries that whittling has come to be looked upon as the national occupation. Mrs. Earle points out that young people who had thus made for themselves so many things used in their houses, grew thereby to know the value of them and to be careful of what had cost them so much labor. Where wood was so plentiful and so varied in its qualities, there was much to make the whittlers both busy and ingenious. All this has been put into verse in a piece once most popular among boys for declamation. It begins

“The Yankee boy, before he’s sent to school,
Well knows the mysteries of that magic tool—the pocket-knife,”

and goes on to tell how the boy will not only make you anything, but “make the thing that makes it.”

In the old days, there was no treasure to the farmer’s boy that compared with a good strong pocket-knife. Some of these are still preserved in museums. Daniel Webster said of them that they were the direct forerunners of the cotton-gin and thousands of noble American inventions.

But to show how the forests, mankind’s earliest home, can really supply nearly every need, we must go to tropical lands. The natives of warmer climates have learned that there are plants furnishing all that their simple lives require. The bamboo—not truly a tree, but a cane—is one of these.

BAMBOO, A PLANT OF MARVELOUS USES.

Let us go back, for example, to the bamboo, which we have already mentioned, and consider briefly what it offers to the dwellers in the land where it grows. It is a great family of plants, distinguished by having light, but strong, tubular stalks, from those hardly bigger than a straw to enormous beams that serve as masts for the largest vessels. These stalks are divided by partitions into watertight sections. Their

interior is a softer wood of straight fibers. The outside is covered with a flinty coating, very thin but nearly or quite as hard as glass.

When the shoots are very young and small, they are eaten, like the shoots of asparagus, and can be salted or otherwise preserved. Both the juice and the buds are used in medicine in the East, and the grains or seeds of the plant can be eaten as we eat cereals; and, owing to some strange reason, they are said to be produced most abundantly when the rice crop in the same regions is scanty. An instance of this occurred in 1812, in India, when the bamboo furnished food for some fifty thousand people. The leaves of some species can be fed to animals for fodder. From the shoots and the seeds also, when rightly treated, can be brewed a kind of beer.

As a fuel-wood, bamboo can not be excelled, as it splits into the tiniest fragments, and burns readily, making a hot, clear fire. It even gives the means of getting fire, since the hard coating will strike fire like a flint, and its tubular shoots can be used to compress air in the form of what is known as the fire-pump, and thus to set fire to tinder. And the tinder itself can be made from the powdered fibers.

Vessels or pipes of all sorts are readily made from the hollowed stems, and the fibers of the wood or of the leaves can be woven into hats, cloaks, garments, mats, cordage, and sandals. From the tree also can be made two kinds of weapons, the blow-gun for propelling tiny arrows, and a bow and arrows, which are readily made from the straight, springy wood, and can be corded with the woven fibers. The arrows need no other pointing than is furnished by the flinty coating. Spears and darts or pikes made in the same way from the other stalks, and even knives for cutting softer substances are prepared by cutting away the softer portion and leaving the hard coating along the edges. The readiness with which the fibers can be split makes

it easy to form pens or brushes, and the paper upon which these are used is also readily prepared from pulp beaten out of the wood from the same tree. No boy needs to be told how readily whistles and flutes are formed from the clear tubes of the bamboo.

The larger shoots form a strong and elastic waterproof material for the construction of every part of man's dwellings, of furniture, of ships and boats, sails, masts, and cordage. One might almost say that the list of things to be made from the bamboo is endless, for the Chinese and the Malays can make almost anything, either from the divided fibers, the wood pulp, or the shoots themselves.

THE COCONUT PALM AND ITS HUNDRED SERVICES.

One may say that the coconut palm ranks in usefulness only second to the bamboo. Its wood provides both houses and boats, and one portion makes beautiful furniture. Its leaves serve as fodder, and as a thatch for roofs. Out of this fiber are made rope, brooms, brushes, mats, and paper. From the nut comes both food and drink, without preparation, and from the same fruit can be made wine, sugar, oil, wax, and other valuable products. The shell can be made into cups, dippers, and other vessels; the husk provides clothing, carpeting, cordage. Candles and soap are made from the oil. The latter is especially useful, since it will lather readily even with salt water.

The circumstance that makes the palm-tree specially valuable is the fact that it is found in oases, the occasional green spots among the sandy deserts. The date palm, besides furnishing a delicious fruit, produces in its trunk a sap called its milk, which, after fermenting, makes an agreeable wine, or when distilled, a spirituous liquor. Like the two trees already described, it furnishes in its wood and its leaves the most varied materials for building, and fibers for weaving.

There are so many species of the palm that they can be told of only in books that are specially devoted to the subject. They include the coconut tree, which rightfully comes under the general heading of the palm, the oil palm, which bears an olive-like fruit from which the oil can be pressed; sago palm, the pith of which furnishes an excellent food; the areca palm, the seed of which is greatly used by the natives of the East for chewing, being a mild stimulant; the rotang, which we know as "ratan," furnishes flexible canes for many uses; and the "wax-palm," whose trunk, some two hundred feet high, is covered with a resinous wax, that has many uses.

There are some 280,000,000 trees—more than a thousand species of palms—growing in tropical countries; and we have mentioned only three or four of the most important. The date-palm, especially, has furnished food to mankind since before history, cakes of dried dates having been found in ancient Egyptian tombs. The town of Bethany, mentioned in the Scriptures, is so called from words meaning "the home of dates." Even the stone of this fruit must contain some nutriment, as it is relished by camels.

A statement of the palms' many uses is very interesting.

The trunk serves for building furniture and implements, and can be hollowed into a canoe. The leaves make thatch, their stalks are paddles, and the fibers are fishing lines. From the blossom and bud come preserves, pickles, and a vegetable food. The pith gives sago, another food, and from the juices, sugar, vinegar, and two beverages, besides the coconut-milk.

The nut gives not only foods, but oils, cream and soap, and fertilizers; and its shell makes many vessels, other husk-fibers, and even a tooth-powder, while near the foot-stalks are webs that make strainers and are inflammable enough to serve as torches.

SOME OTHER TROPICAL TREES.

Another useful tree is the breadfruit of Ceylon, a remarkable tree. The fruit is baked and eaten by the natives as we eat bread, and is equally good and nutritious. In Barbatu, South America, is a tree which by piercing the trunk produces milk, with which the inhabitants feed their children. In the interior of Africa is a tree which produces excellent butter. It is said to resemble the American oak, and its fruit, from which the butter is prepared, is not unlike the olive. Park, the great traveler, declared that the butter surpassed any made in England from cows' milk.

Sierra Leone has a tree which produces cream fruit, which is agreeable to the taste. At Table Bay, near the Cape of Good Hope, is a small tree, the berries of which make useful candies. It is also found in the Azores. The vegetable tallow tree also grows in Sumatra. In the Island of Chusan large quantities of oil and tallow are extracted from its fruit, which is gathered in November or December, when the tree has lost its leaves.

The weeping tree of the Canary Islands is a kind of arboreal freak. This tree in the driest weather will rain down showers from its leaves and the natives gather up the water from the pool formed at the foot of the trunk and find it pure and fresh. The tree exudes the water from innumerable pores situated at the base of the leaves.

TREES OF TEMPERATE REGIONS.

The benefits of these plants are confined mainly to tropical regions, but if we in temperate climes have no such generally useful plant, we have in our forests a variety that in one way or another supplies all the needs met by those blessings of the tropics. We have already told in this book of the use of fruits and nuts for food, having mentioned sugar derived from maple sap, the resins, gums, tar and turpentine, found in



THE LARGEST TREE IN THE WORLD.—This great tree is a Giant Sequoia and grows on Mt. Rob Roy in California. Its circumference is one hundred and nine feet. Count the number of men standing against its base with plenty of room for more.

hardier northern trees. The oaks, by reason of the peculiar bends of the branches and the almost metal-like hardness of the wood, furnish an ideal substance for the great ribs supporting the planking of shipping. And it is to the oak-tree that the great seafaring nations of modern times owed the stout ships that enabled them to penetrate the oceans and to reach the utmost parts of the earth, ages before ships of metal could be made.

THE OAKS.

The oaks gave the ribs and planking, and the tall, tapering pine-trees were, until the use of metal in ship-building, carefully protected and saved by Government officers to make the masts and yards upon which their sails were stretched. As we know from the early history of the United States Government, inspectors were accustomed to go through the forests and mark the taller pine-trees most suitable for masts in the Royal navy. So highly was the oak valued in olden times that wherever it is mentioned in the most ancient writings it is said to be sacred to the gods. The oak groves were chosen as the abodes of the priests, who used the boughs and leaves in their ceremonies. There are a number of individual oaks celebrated in history. In that of England we have mention of the tree against which an arrow glanced and killed William Rufus, the Royal Oak at Boscobel, wherein Charles II hid himself after losing the battle of Worcester; and we are told that there is still standing the oak under which the Scottish hero, Wallace, gathered his followers, and another, at Oxford, called Alfred's Oak, which was standing when that ancient university was founded.

In Hampton Court Park near London is a famous old oak, thought by many to be as old as any in England. It is described thus: The tree, which is situated close to the south side of the Long Water, is reputed to be about a thousand years of age, and it is probably the oldest oak tree in England. Its gigantic

trunk two feet from the ground measures about forty-five feet around, and being quite hollow offers standing room for about a dozen persons. The sides, however, are so sturdy as to give support to a number of branches, some of them dead wood, but the greater number are still alive and come into bud every year. Some time ago a quantity of dried grass and paper was placed in the trunk by, it is supposed, mischievous boys, and set alight, with the result that the old oak was nearly destroyed.

The Charter Oak of the State of Connecticut is celebrated; and there is even an old tree known as Abraham's Oak, in Palestine, which has been known certainly for hundreds of years. These are but a few of the ancient oaks whose age certainly exceeds two or three centuries, for the tree has been an object of veneration as far back as we can trace the history of man. It is even thought that the great columns of Greek and Roman temples, with spreading base and varied sides, were imitations in artistic form of the oak trunk, for it is known that many ancient buildings formed their columns of massive oak timbers.

THE OLD OAK FORESTS.

England was once largely covered with forests in which the oak-tree was the most plentiful of all, and not until the time of Henry VIII was it found necessary to preserve these trees and to plant new ones. The best oak timber is looked upon as the most valuable of all wood grown in temperate climates. It is hard, of close grain, does not split nor rot readily in water. Not only is it good for buildings and ships, but for making carts, wheels, and every kind of furniture. The value of the bark for tanning has already been spoken of, and the grains furnish a rich and nutritious food for animals, hogs especially thriving upon it, for which reason oak groves were much valued in early Saxon times as we learn from Scott's *Ivanhoe*.

Some species of acorns are also eaten by the poor when other food is scarce, and one kind at least furnishes a desirable food. Again we are prevented by the number of varieties from discussing the oaks' many uses. Nearly all sorts produce valuable woods, tanning bark, or a food for men, animals, or poultry. Where the wood can not otherwise be used, it is an excellent fuel, burning slowly and producing hot cinders. Some species are used for ornamental plants.

Some idea of the amount of wood contained in a single oak is given by this account of a Pennsylvanian tree: "The tree was five feet across the stump and took the men several hours to place it prostrate. Eleven hundred and three large wagon spokes were taken from the trunk and twelve cords of wood were cut from the top and branches."

One thing for which we have to thank a species of oak is the light bark known as cork, which has been known for at least some nineteen hundred years. It has been more fully described when speaking of valuable barks. Another substance which indirectly we owe to the oak is the gall produced when a certain insect penetrates the oak leaves, laying eggs in them. The use of the gall for ink making is well known.

RECENT SUBSTITUTES FOR WOOD.

It is hardly necessary to say that the use of wood, while it is greatly increasing on account of the greater number of people in our country, is lessened by the substitutes that have taken its place in many industries. Instead of great wooden bridges, steel or iron frames are thrown across rivers; the thousands of rails that made heavy and awkward fences are now replaced by light wires; great timbers for building purposes are now seldom seen except for ornamental use in interiors; and steel beams are both lighter and stronger, and are fireproof. We all know that there must be a great saving in the use of wood for fuel,

since coal, petroleum, gas, and electricity now give us light and warmth. Metal, and gravel in tar, or stucco, have largely served to spare the shingles and clapboards which were not only used in enormous quantities, but which needed to be renewed at longer and shorter intervals. While furniture and interior fittings still consume enormous quantities of wood, yet here we see a widespread use of other materials tending to preserve our forests for other purposes.

NEW USES FOR WOOD.

On the other hand, paper, now more used than ever before, which once was made of rags, is now in large part manufactured from spruce, poplar, and other woods ground up and converted into pulp. Telegraph poles and railroad ties are also a new demand within the last century, and have consumed a great part of the forests while we are engaged in finding suitable substitutes. It is believed, however, that in time metal and concrete will replace wood for these uses. The manufacture of wooden articles has greatly increased also, through the invention of quick-working wood machinery which enable men by steam or water power to vastly increase the product of wooden articles while greatly saving in the cost of production.

Until recently the white pine has been most used of any lumber in America for building purposes, but it is now becoming expensive through its rarity, and other woods, harder to work, are taking its place. Other lumber-trees are the hemlock, spruce, fir, and the redwood. The cedars furnish a fine-grained wood very valuable for interior finish and the making of pencils and cigar-boxes. The larch, or tamarack, is still used in ship-building, and the cypress of Alaska is coming into use as a cabinet wood. Other fine hard woods are the maples, some varieties of which have a beautiful grain, the oak as already mentioned, black walnut, cherry, butternut, the ash, and the chestnut.

In fact, use has been found in modern civilization for nearly every variety of wood, according to the fineness of its grain, its toughness, and its capacity for taking finish. There are a large number of beautiful foreign woods, which, owing to the demand, have been so growing in value that they are now often imitated by the staining, varnishing, or polishing, of cheaper native woods. But they are still used in a few ways for which they are especially adapted.

WOODS USED IN SMALL ARTICLES.

Some of the uses of wood of which we do not often think as requiring a large quantity of material, really make a heavy drain upon the forests of the world. Even so tiny a thing as a match, with its mere splinter of fuel, capped by chemicals, when it is produced at the rate of millions a day in a single factory, means the exhaustion of a large section of woodland, unless care is taken to replace the trees by planting. The wooden boxes for matches, made by peeling off thin shavings from the heavy trunk of wood, not only require a large amount of material, but it is material that goes at once to waste, like the burnt match itself, being used only once and then thrown away. Tooth-picks, wooden pegs, spills for lighting, thin boxes, all turned out in large quantities and soon destroyed, make a great and constant drain upon our forests.

In the same class with the matchboxes must be placed the enormous number of baskets, frames, and boxes used for packing fruits, berries, groceries, and, indeed, light articles of every sort; these, too, serve no further purpose unless perhaps that of kindling. It is likely that these minor uses of wood, though they seem but trifling in the case of each household, yet may exceed in their final total the demands made upon woodlands by the use of larger pieces for furniture, tool-handles, framework, great packing-boxes, and other ways of using wood that supply our demands for

a longer time. A piano, for example, or a stringed instrument such as the violin, though it requires specially chosen and prepared wood, remains useful for year after year, while the constant drain of the tiny bits that are used but once and then go to the waste heap may be likened to the small leak that (the proverb tells us) will sink a large ship.

VARIETY OF WOODS IN A PIANO.

A piano requires a large variety, perhaps eight or ten different kinds of choice woods—pine, oak, beech, mahogany, rosewood, the metal-like black ebony, and almost any of the more precious woods are suitable for the fancy cases. The number of pieces used runs up into the thousands, and the tone of a piano depends largely upon the soundness and fineness of the chosen woods that compose it. Especially important in all musical instruments are the broad pieces that, like the sounding-board of a piano, give resonance and power. In the piano the sounding-board is of fir, or spruce, woods tough enough to resist the strain of the hundreds of steel wires, and yet light and elastic, so that it will vibrate. The violin is a masterpiece of wood-making, and is a wonderful illustration of the good qualities of the various woods composing it. Though a mere hollow shell of thin pieces, it resists an enormous strain, and yet must be entirely elastic and delicately alive to the tones set up by the vibrant strings.

FOR PICTURE MAKING.

Until recently we had to have the firm, tough grain of boxwood for nearly all the pictures in books and periodicals. In fact, printing itself began, if we may believe the Chinese historians, in the carving of letters upon wooden blocks, and this was the first method of printing used in Europe. So both art and literature were founded upon the wonderful qualities of the substance of wood. Only very recently have mechanical and chemical ways of making pictures set aside the

wood block in favor of metal surfaces, though even these are today often fastened to a wood foundation, which gives a cheaper, lighter and more elastic base for the plate.

THE OLD LOOMS.

Another great industry in which wood has given way to metal is weaving. The old looms, from the days of savages to the recent times of cheapness of metal, were made first of a few straight sticks, and afterwards of a framework constructed of heavy beams, and lighter pieces which held the web of cloth. The shuttle itself, to carry to and fro the thread of the woof, found just the right material to give it weight and smoothness in the hard applewood or box. There were a dozen tradesmen engaged in making parts of the old wooden looms, spools, shuttles, beams—today we hardly know the names. While now the great machine looms are largely made of metal, they are, after all, simply substitutes for the old wooden machines upon which our ancestors depended for every form of cloth and fabric. So, in addition to metal and pottery, we owe also all cloth to the qualities that fitted wood to the construction of looms.

SPECIAL USES FOR WOODS.

We shall not attempt to cover all the woods that may be substituted for one another, but merely mention a few that have special uses to which they are peculiarly fitted, as for example, what boxwood is to engraving and the oak to shipbuilding.

The trees known as the cone-bearers include the pines, which are mainly useful for lumber and for fuel, having a fine grain that fits them for building and an oily sap that makes them burn readily. Some kinds are soft and fine-grained, others take an excellent polish. From the southern pine comes turpentine, which runs directly from the inner bark; tar, which can be extracted by heat from the dead branches and

trunks after the tree has ceased to yield turpentine; pitch, and resin, all of which yield products which modern chemistry is increasing every day.

Then come the spruces, which are ornamental and furnish wood for building and for musical instruments, the Norway spruce being often chosen for the backs of violins and for piano sounding-boards. The fir trees yield a soft, readily worked wood, and a resin known as Canada balsam, used by physicians and to mount objects for the microscope, or as clear cement to fasten lenses together. The larch, or hemlock, gives a strong, soft, durable wood suitable for heavy work, and it also yields excellent tannin and turpentine. The cedar trees furnish the scented wood that is unpleasant to moths and other insects, and boxes are made of it for the preservation of clothing. It also gives us wood of just the right texture for pencils and for cigar boxes. The hemlock, the cypress, and the arbor vitæ have, in general, the same qualities as the rest of the family, both in their timber and their extracts. Many of the cone-bearers also furnish edible seeds, for men or animals.

There is a general division among woodworkers of their material into hard and soft woods, the difference consisting in more or less compactness of the cells and fibers. The hard woods range from those that are dense enough almost to sink in water, and those that are suitable for making into articles of ordinary use, such as furniture. The soft woods can be used for purposes that require little strength, some of the softest being readily dented by the finger-nail. The hard woods take a fine polish, and resist in some cases almost like metal. The soft woods can be readily shaved into thin slices, and then used almost like paper.

AN EXAMPLE OF SPECIAL USE—CEDAR.

One of the greatest demands for Spanish cedar is for the making of cigar boxes. These boxes were formerly all made of Spanish cedar and practically all

of the wood was brought from Cuba. There are cedars in the United States, a plentiful supply of white cedar in Oregon, and more or less red cedar in the South; but those wouldn't do for cigar-box timber.

The freshly cut wood of our own cedar trees has a pungent, pleasing odor. But if after that you sniff a sheet of freshly cut Spanish cedar the difference is marked. The Spanish has a very mild, delicate, agreeable odor, compared with which that of the native red cedar seems strong and rank. Spanish cedar appears to be the wood in every way best adapted for the keeping of tobacco in its best state.

But about forty years ago, with the consumption of Spanish cedar increasing and prices creeping up, a cheaper wood was sought, which must also be odorless so that it would not affect the cigars packed in it. This wood was found in poplar, which is now used extensively.

Poplar for cigar-box lumber is cut in the United States in the mountains of southwestern Virginia, West Virginia, eastern Tennessee and western North Carolina. Spanish cedar is still used exclusively for the finer grade of cigars, poplar largely for the other grades. Of all the cigar-box lumber sawed in the United States at the present time about two-thirds is Spanish cedar, one-third poplar.

The Spanish cedar-tree grows to a height of thirty or forty feet before branching and it may have a bole from twelve to twenty-eight inches or more in diameter. It is imported into this country cut in logs about twelve feet long.

There is sawed in the United States annually of Spanish cedar from fifteen to twenty million feet, board measure, making up into somewhat between seventy-five and a hundred million feet of cigar-box lumber.

PRESERVING THE FORESTS.

When so much wood goes into so small a single article, it is easy to understand why whole forests are

being swept away to fill our needs for the various woods.

The subject of forestry, or the scientific management of the great wood crop is one that has recently been attracting special attention, for vast as were the original forests, they have disappeared so rapidly in the more settled portions of civilized countries that it has become necessary to preserve and manage them scientifically in order that there may not soon be a true wood famine. Whether the existence of forests exerts a very great influence upon climate is still a somewhat disputed question, but the weight of opinion certainly is on the side of such management as will keep the country well wooded while permitting the use of a fair portion of the wood crop every year. In most civilized countries nowadays the care of the forests is an important part of the government, and great areas are set apart as forest reserves for the general benefit. The whole science is comparatively a new one, but, especially in Germany and Switzerland, enough has been done to show the wisdom of controlling the cutting of trees.

Although the Department of Forestry is rather a new one in the United States, and has not as yet been so well developed as those of Germany and other European countries, yet it cares for nearly two hundred million acres of forest land, at a cost of less than two million dollars, the cost of the service, therefore, being about one cent an acre. This has not only cared for much of the woods, but paid for scientific work besides. The service employs a little over three thousand people, and, considering its size and cost, has been of wonderful benefit to the country. One of its main objects is to replace by new plants those which are cut. Some twenty million of seedlings are being raised, and many new species are being tried.

Another important form of their work is to look into the killing of trees by insects and by plant dis-



TYPICAL WOODS.—1. Yellow Locust; 2. Chestnut; 3. American Beech; 4. Shell-back Hickory; 5. Silver Maple; 6. Live Oak; 7. White Birch; 8. Wild Black Cherry; 9. American Holly; 10. American Elm; 11. White Pine; 12. White Spruce; 13. Black Ash; 14. Tulip Tree or Whitewood; 15. Redwood; 16. White Oak; 17. Sycamore; 18. White Cedar; 19. Black Walnut; 20. Yellow Willow.

ease, since the work of harmful insects has cost the country an average of over sixty million dollars a year. Perhaps as much damage is done by forest fires. Certainly, together, fire and insects cost the country something like a hundred million dollars yearly, and it is believed that the greater part of this loss is unnecessary. The only cause which can not be controlled in fighting fire is lightning. About two-thirds of all fires discovered are put out by guards and rangers.

An official of the Forestry Department who has been spending several years in the Philippine forests declares that while the United States uses forty-one billions of feet of timber each year, fully a quarter of all this might be raised in the Philippines, except that it would be too expensive to bring it across the Pacific. There is, however, a market for this timber in China.

Among the valuable woods in the Philippines are two that will serve as substitutes for mahogany and for teak, both rather expensive timbers.

THE MODERN DEMAND FOR WOODS.

In the old times, each race depended largely upon the timber and other plant products of their own country, but the demand for various woods is now world-wide. Merchants travel thousands of miles to find those which are called for, and transport them to the other side of the world, selling them at prices that more than pay the cost of carriage. Prices are generally rising, and the quality of wood going down.

We are now told there is fear of a wood scarcity, the result of wastefulness. In time the world will have learned how to treat its forests as a source of supply that can be renewed, for civilized countries have shown it possible to derive a steady supply of material from the forests without harm to them, if the cutting is done wisely and replanting resorted to

for the purpose of making good the loss. The first step toward this right management is to put the remaining forest lands under government control, or to compel owners of such lands to manage them with wisdom. The caring for forests has become a learned profession, as well as an art, and is proving a most attractive calling for young men from the universities.

HERBS AND SHRUBS.

These words are used by both ordinary people and by botanists, and with slightly varying meanings. When the botanist speaks of herbs, he has in mind plants that put up a new stem every year, to last only for a season. This stem does not form a hard, woody fiber, and so either the plant, or the stem as far as the root, dies when the bearing season is over.

The word "shrub," as used by the botanist, denotes a plant generally smaller than a tree, but one that forms a woody stem, branching from, or near, the ground. It is not merely a question of size, for trees may be very small and shrubs as large as small trees; but, generally, shrubs have a number of stems, not differing greatly in size, instead of one principal trunk. The herbs, too, sometimes resemble the shrubs very closely, having stems more or less woody. But, in general, the meaning of the words is as given.

In common usage, the word "herb" is likely to be given to such small plants as yield drugs, or flavorings, or can be used as perfumes or garnishing. And in the same way the ordinary use of "shrub" is to mean any bushy growth, whether, strictly speaking, it is entitled to the botanical name or is merely a young growth. Its common use is seen in the word "shrubby," as applied to all sorts of small growth of a bushy kind.

Although formerly it was the custom to divide plants into many classes of which herbs and trees were

separate, it has been found that no such division can accurately be made. There is no such division made in nature, since it depends mainly upon the size of the plant, and this has no connection with its plan of life or the way it is made up. Although at the time when a great French botanist tried to arrange most of the known plants in these two divisions, he was able to make a fair division between them, yet since his time new species have been continually discovered, and many, or in fact, most of them could as well be put under either heading. An English botanist of a later date, when he tried to make up his classes, was careful to say that in nature there was no such exact line of division as botanists try to fix. As he wrote, "Nature makes no leaps, passing from one extreme to another, but takes a middle course . . . producing things partaking of the qualities of the objects which most resemble them on either side, as if to connect them, leaving it doubtful to which of the two they belong. . . . She is in the habit, in every part of creation, of producing singular and anomalous species which form exceptions to the general rule."

THE LAW OF PLANT LIFE.

Since his time it has been learned that the law which arranges how plants shall be made is the law of their own needs. This brings it about that plants living under the same set of conditions are likely to become suited to their surroundings by the same or similar changes. Thus there is a general likeness among plants growing in dry soils, since they must either become so changed as to keep moisture from drying out of them, or they will die. Those in damp climates may be formed on a different plan, since they can live, even if their moisture is not so carefully retained. It thereby comes about that plants which have to live under the same conditions will, in some respects, come to be like one another. There might be a thou-

sand examples given of this, for all vegetable life illustrates it.

One of the great names in the history of botany is that of the poet Goethe, who early announced that many of the different organs of plants were mere changes made from the original leaf, which was either contracted or expanded, took on or gave up color, or was otherwise changed to suit the needs of the plant. It is now well known that a plant may be made to change the forms of many of its parts completely, if it be necessary to its existence. What is a root below the surface, becomes a stalk above; buds may be produced or checked; branches may be bent down into the earth, and made to take root; and all these and similar changes will take place naturally when need arises.

CHAPTER XIII.

Barks and Basts.

IN early days upon the earth, when all men were savages, when life was primitive, before men had found out or invented any of the conveniences which afterward came into use, people supplied their actual needs from the natural products about them. When primitive man got tired of living altogether in the open, exposed to the attacks of wild beasts, to all the rains that fell and the winds that blew, he began to look about him for weapons and shelter and clothing. All around him were trees and plants, and to those he turned for his supplies: a handy tree-branch made him a rude club, fruit was his food, and when he thought he needed it he made a little clothing of grass and leaves. When he could not find a convenient cave he made himself a shelter of tree-boughs and grass, daubed with mud, perhaps, or covered with bark.

Forced by necessity men soon learned to make use of what the trees had to give; and to early man, who had no proper woodworking tools, nothing was more valuable or more useful than the bark of a tree, both outer and inner bark. Many of the uses to which primitive man put the bark of trees may be seen now among savage tribes; many other uses were handed down from generation to generation and are still found, even among highly civilized peoples.

The bark of a tree is in two parts, the outer, or rough, corky layer, and the inner layer, smooth and tough, called *bast*. With bark men made huts and boats and household utensils; from the bast they made cordage and clothing. Barks of trees gave them medi-

cine to cure their sickness, and dye-stuffs to make their clothing gay; trees gave them weapons, clubs and spears and bows; thorns tipped their arrows. In later days the bark of trees gave men their first writing materials, and the words of today tell what these were. The word *book* comes from the Anglo-Saxon *boc*, meaning *bark*, for the early Anglo-Saxons used the inner bark of trees to write on, or to draw their rude sign-pictures on. *Library*, a collection of books, is from the Latin *liber*, a book, which in the beginning meant the inner bark of a tree, used for writing upon. The word *paper* comes from *papyrus*, a tall reed from the woody stem of which the ancient Egyptians made the first paper; and the *leaves* of a book speak of their origin for themselves.

THE LODGE IN THE DESERT.

An old, old tradition of the Navajo Indians of the Southwest shows how the use of bark and bast goes back to a time before history, and how primitive man made his home and his weapons and his clothing. It gives a picture of what life was in those old days.

“Many, many years ago,” so the story begins, “in the neighborhood of Dsilyi’-quojoni, in the Carrizo Mountains [in New Mexico] dwelt a family of six: the father, the mother, two sons and two daughters. They did not live all the time in one spot, but moved from place to place. The young men hunted rabbits and wood-rats, for it was such small animals that they could catch for meat. The girls gathered the wild seeds that were good to eat.

“After a time they went to a place called Wings of the Rock, but there was no water there. The elder brother saw a sandy mound, with green things growing on it, and thought that where there were growing things there must be water, so that he went to the mound and searched about it. He found a moist spot near it; so he took his digging-stick and dug a hole,

until suddenly the water gushed out of the earth and filled the hole. They had but one water-bottle, woven of wicker, water-tight, so they moved the camp to the vicinity of the spring. They had a stone ax-head with a groove on it. Around this they bent a flexible twig of oak, and tied it with the fibers of the yucca, and thus they made a handle.

“The first day after the spring was found the young men went out and chopped all day, and in the evening brought home four poles, while the old man, with his digging-stick, dug a hole in the side of the mound, so that the cut banks made the back wall and part of the side of the side walls of the hut.

“They worked thus for four days, and the lodge was finished. They made mats of hay to lie on and a mat of some of the same material to hang in the doorway. They made mats of fine cedar bark with which to cover themselves in bed, for in those days the Navajo did not weave blankets such as they make now. The soles of their moccasins were made of hay and the upper parts of yucca fibers. Cedar cloth and the skins of little animals made their clothing.”

THE IROQUOIS LONG-HOUSE.

As experience taught men they gradually grew more skilful and ingenious in the use of the material they found ready to their hand; and the manifold uses of bark were never better shown than among the North American Indians, one of the foremost tribes of whom was the Iroquois. This tribe was at the head of the great Iroquois Confederacy, Six Nations, the strongest confederation of Red Men that history knew, the center of which was the present State of New York, and which held dominion from the Atlantic to the Ohio country, from Lake Ontario to the Potomac.

The Iroquois lived in comparatively large communities, and built houses capable of accommodating several families, sometimes twelve or fifteen. These were

called "long-houses"; they were from fifty to one hundred and thirty feet long by about sixteen feet wide, and were divided into separate rooms at every twelve feet by bark partitions. The houses were made of a framework of posts and poles, fastened together with ropes made of the tough bast of various trees. The framework was covered with the bark of the red elm or of the ash, rough side out, taken from the trees in spring or summer when the sap was flowing, when it



Bark House of Iroquois Indians

could easily be removed, which was not the case in winter. Making two cuts through the bark, one just above the ground, the other below the lowest branches, clear around the tree, and a third cut vertically from one circular cut to another, the Indians separated the bark from the trunk with wooden wedges. The big cylinders of bark were then flattened, while green and flexible. When dry the bark was cut into the shape of boards and held in place on the sidewalls of the house by transverse poles, fastened with splints or bark rope. The roof was made of bark, the grain running up and down so as to shed water, the pieces of bark being

stitched together with root-twine, making overlapping seams; and the whole was held fast by long poles, fastened to the framework of the house with bark ropes. There was a door in each end of the long-house made of a sheet of bark hung on wooden hinges. The seats and beds were made by putting crotched stakes in the earth floor, near the walls, with poles laid lengthwise and across, on top of which sheets of bark were laid smoothly, the whole being covered with the skins of wild animals.

BARK STOREHOUSES AND BARRELS.

The Iroquois and other American Indians made storehouses in the earth, in which to store their corn, acorns, nuts, seeds, dried berries, and similar food, for winter, or as hiding places for provisions while they went to another place. These storehouses were pits, lined with bark, and with a water-tight bark cover, over which earth was placed. This custom was largely followed by all the tribes; and storehouses of the same description have been found at the village sites of the Mound-Builders, the predecessors of the Indians, who built the earthen walls and mounds that are found by the thousands in the valley of the Mississippi, being especially numerous in Ohio. Some of these pits, when uncovered still held the remains of corn and other seeds, and nuts, while others were full of refuse, showing that the pits, when discarded as storehouses, were used to hide the village refuse.

For ropes the Iroquois, in common with other Indians, used the inner bark, or bast, of the slippery elm, the red elm, the basswood or linden, and of other trees. The bast was split into narrow strips and boiled in wood ashes and water, after which the fibers making the bast could easily be separated. These fibers were twisted separately into strings for tying or sewing, were braided or knit together into longer bands with

a single knitting-needle made of hickory, or twisted into ropes. The bark of the slippery elm was the best, and ropes 40 or 50 feet long were made.

Barrels were made from the bast of the red elm. A section of bark was removed from around the tree; this was stitched up the side, a bark bottom stitched in and a bark top fastened on with a bark hinge. These were used to store corn and other food, in the long-house, and lasted for many years. Bark trays of all sizes were made. Sieves were made with a rim of bark and a bottom of bark strings, woven closely, for sifting pounded corn for corn-meal. Boxes for holding maple-sugar, water-pails, and many other articles were also made. The Iroquois held a festival every spring in honor of the maple tree, just before sugar-making time in early spring. They gathered the maple sap in bark troughs holding about two gallons, and emptied these into a bark trough as long as a canoe.

WHAT THE PIONEERS DID.

In the days when the American settlers first adventured from the Atlantic coast into the great wilderness they learned to use bark as the Indians did, because they had few means of transportation, no roads, and could not carry much with them. One of the men who pushed out into the wild Northwest Territory, west of the Alleghenies and north of the Ohio, when that country was still the home of wild animals and wilder savages, wrote, in after years, of the early struggle.

“As soon as the bark would run, [peel off]” he wrote, “we would make ropes and bark boxes. These we stood in great need of, as such things as bureaus, stands, wardrobes or even barrels, were not to be had. The manner of making ropes of linn [basswood] bark was to cut the bark into strips of convenient length, and water-rot it in the same manner as rotting hemp or flax. When this was done the inner bark

would peel off and split up fine so as to make a pretty considerably rough and good-for-but-little kind of rope. Of this, however, we were very glad, and let no shipowner with his grass ropes laugh at us.

“We made two kinds of boxes for furniture. One kind was of hickory bark with the outside shaved off . . . A much finer article was made of slippery elm bark, shaved smooth and with the inside out, bent round and sewed together where the ends of the hoop or main bark lapped over. A bottom was made of a piece of the same bark dried flat, and a lid, like that of a common band-box, made in the same way. This was the finest furniture in a lady’s dressing-room, and then, as now, with the finest furniture, the lapped or sewed side was turned to the wall and the prettiest part to the spectator. They were usually made oval, and while the bark was green were easily ornamented with drawings of birds, trees, etc., agreeably to the taste and skill of the fair manufacturer.”

Another pioneer tells of working so hard to build his cabin before winter that he wore the skin off of the inside of his hands, which were very sore until he learned from an Indian to boil oak bark in water and wash his hands in the decoction, “when,” he adds, “they soon got well.” His Indian guide taught him how to make spoons of “linn” bark, and how to roof his cabin with bark strips. The pioneers even used hickory bark, stripped from around the tree in a big cylinder, for coffins. When they could not get resinous pine wood to serve as torches, they gathered strips of the shell-bark hickory, which burns with a clear, bright flame, and by its light, on winter evenings, made their rough furniture, shelled corn for food, or read the few books they had been able to carry with them.

HIAWATHA’S CANOE.

Of all the trees of northern North America few were so useful to the Indians as the birch, especially

the canoe—or paper-birch. They used its bark in numerous ways, the most important, probably, being that described by an old writer in a book called *The New English Canaan*, when he wrote of the birch: “Of the bark of these the Salvages of the Northern parts do make their delicate Canowes.” In Longfellow’s beautiful poem, “The Song of Hiawatha,” he tells how Hiawatha calls to the trees for help in the making of a canoe. The lines are taken here and there:

“Give me of your bark, O Birch-Tree !
Of your yellow bark, O Birch-Tree !
I a light canoe will build me,
That shall float upon the river,
Like a yellow leaf in Autumn.
Give me of your boughs, O Cedar !
Of your strong and pliant branches,
My canoe to make more steady.
Give me of your roots, O Tamarack !
Of your fibrous roots, O Larch-Tree !
My canoe to bind together.
Give me of your balm, O Fir-Tree !
Of your balsam and your resin,
So to close the seams together
That the water may not enter.”
Thus the Birch Canoe was builded
In the valley by the river.
And it floated on the river
Like a yellow leaf in Autumn.

This tells the story of the building of the canoe; how the frame was made of cedar-boughs, or hickory, covered with broad sheets of the canoe birch or black birch, sewed with the twisted fibers of the larch-roots and pitched with resin from a fir or pine. On the sides of the canoe, at each end and on both sides, were often worked ornamental designs of porcupine quills dyed in bright colors with stains made from barks and plants. The birch-bark is tough, resinous and impenetrable by water. The Indians further south used the bark of the red elm or the bitter-nut hickory, having no birch. These were not so good as birch, for birch

does not warp when wet, while the elm or hickory canoes had to be hauled out on land to dry after being used. A birch-bark canoe is very light, withstands hard usage and will carry considerable weight. In the days when the fur-trade was at its height through all the region of the Great Lakes, the canoes were often twenty-five feet long, capable of carrying a dozen men



Birchbark Canoe. Chippewa Model

or two tons of furs or supplies. The Indians of South America made their canoes out of the trunks of trees, laboriously cut down, shaped and dug out by fire and stone implements.

AN ARBOREAL DEPARTMENT STORE.

The birch-tree, both in America and in northern Europe supplied men with many of the necessities of life, and its products are still used extensively. The Canadian Indians use its bark for making boxes, pails, buckets, dishes, troughs, and to cover huts and wigwams. It was also used for writing material, not only for the sign-writing of the Indians but by the settlers. Birch-bark boxes, prettily ornamented with

beads or colored quills are a familiar object on sale at many northern pleasure-resorts.

Birch-bark is peculiarly useful because of a resin, called betulin, which exists in it, rendering it impervious to water and making it last for many years without decaying. In northern Europe the white birch furnishes a bark that is used in many ways. It is placed around the bottom of posts and around the sill-timbers of buildings to preserve them from decaying by contact with the earth; it is put on the tops of walls; used for roofing; placed around the masonry of vaults and cisterns to make them watertight. In Russia and Poland the peasants use the bark for boxes, baskets, ropes, boots and shoes; the Laplanders make a waterproof cloak of it, while the natives of Kamchatka pound up the inner bark with the fat of animals and eat it. Birch-twigs make hoops, brooms and baskets. Vinegar and a sort of wine are made from the sap; its leaves are used to make a yellow dye; and the outer bark is used for tanning. This outer bark is rich in tannin and full of an oil which gives the peculiar color and odor to Russian leather. This one tree furnishes food, clothing, shelter, household utensils and means of travel.

PALM-TREES AND COCONUTS.

What the birch tree is to the dwellers in the northern countries, the different varieties of palm-trees are to the inhabitants of tropical and sub-tropical lands. Palms or palmettoes grow in Asia, Africa, North and South America and in the islands of the seas, and all of them are useful to the people. A coconut, to one who knows how to read it, tells a story of food, clothing, fire, light, house and furniture. When a native African wants a hut he plants posts in the ground and makes the walls and roof of palm-leaves; his wife or wives weave the fibrous leaf-stems, split, into baskets, rough hats, and sleeping-mats. At the base of the leaf-stems grows a rough fiber which the

women weave into rude cloth or make into sieve-bottoms. The familiar coconut of the markets is really the berry of the coconut-palm, and is encased in an outer husk, which is stripped off before the nuts are exported. From this husk comes a strong fiber which is woven or twisted into rope and cordage, used extensively in China, India and the surrounding countries under the name of "coir."

If the native, after making his hut, is hungry and thirsty, he climbs the palm-tree after nuts. He relieves his hunger with the white kernel and quenches his thirst with the coconut milk. From the hard shell of the nut he makes sauces, dishes, bottles and lamps. In the shell lamp he puts palm-oil and a floating wick of palm fiber. Other uses are told elsewhere in this volume.

The product of the oil-palm of western Africa is used extensively in the making of toilet soaps. One of the chief industries of the Pacific islands is the gathering of "copra," which is the dried meat of the coconut, which is exported to America, England and other countries where oil is pressed from it and used in many ways.

The cabbage-palm, a splendid tree, furnishes leaves often twenty feet long and six feet broad for the walls and roofs of huts in South America. The petioles, or sheaths which clasp the leaf-buds, grow hard and stiff, and furnish ready-made cradles for Indian and Negro babies. They are also used as surgeons' splints; the thin inner bark, dried, is used for writing material. The familiar palm-leaf fan is made from the leaves of the palmetto or fan-palm.

In the South Atlantic States of America the palmetto is a familiar feature in the landscape. Coarse hats, mats and baskets are made from its leaves; and there is a large industry in making the bark-fiber into bristles for scrubbing-brushes and rough brooms. A description of a house of the Seminole Indians of the Florida Everglades says: "This house is approxi-

mately sixteen by nine feet in ground measurement, made almost wholly, if not altogether, of materials taken from the palmetto-tree. Eight upright palmetto logs support the roof, which is thatched with palmetto-leaves. A platform of palmetto logs, split, with the flat side up, is fastened to the upright logs, about three feet above the ground, for the floor. The whole house is held together by ropes of palmetto-fiber. Sieves, bags and mats are also made of the fiber and leaves." Palmetto logs played a part in the defeat of the British fleet in its attack on Fort Moultrie, in Charleston harbor, during the Revolution, as told in history.

THE STURDY OAK.

The oak tree has figured in history, tradition and story from earliest times; the Romans gave a crown of oak-leaves to any citizen who rendered a great public service; the Druids, the ancient British priests, venerated the oak, and wore wreaths of its leaves while at their celebrations. Robin Hood, the merry archer of song and story, used a great hollow oak in Sherwood forest in which to hang venison, and for many years it was known as the "Larder Oak."

In early England the oak was valued for its wood, used in ship-building, and for its acorns, which are really *oak-corns*, the Anglo-Saxon name for the oak being *ac*. Swine were fed on the acorns and many of the poorer people ate them also. Oak-bark has been used for centuries in tanning leather, being rich in a substance called *tannin*, which is also used in medicine, making an excellent astringent gargle for various throat-troubles. In Europe plantations of oaks are grown to furnish bark for tanning; in America vast quantities of hemlock-bark are used for the same purpose, as well as oak. The acorn-cups of the *valonia*-oak are gathered in Syria and Greece and exported for tanning fine leather. A black dye is made from the bark of several species of oak; and a valuable yellow

dye comes from the inner bark of the quercitron-oak of the Southern United States. On the great live-oaks of the South grow the long, slender strands of the so-called Spanish moss, which drapes oaks and pines and other forest trees in a lilac-gray mantle, giving an indescribably minor note to the landscape. This moss, gathered and dried, is used to stuff cushions and mattresses, there being a commercial use for it in considerable quantities. In old times it used to be a common belief that meat cooked over a fire of oak-bark or chips was especially good for sick people, but that it was unwholesome to sleep under an oak-tree.

WHERE CORK COMES FROM.

Everybody knows what "a cork" is—it is a stopper for a bottle; but many people do not know what "cork" is. Cork is the outer bark of a species of evergreen-oak, cultivated principally in Spain and Portugal, though of late years, a large supply comes from Algeria, where the tree grows plentifully. In gathering cork the first step is the removal, in the spring, when the sap flows freely, of the natural layer of old, or "male" cork, which is worthless except for tanning. The new bark which forms after the old has been removed is the cork of commerce. The first stripping of real cork takes place when the tree is fifteen or seventeen years old. The second stripping takes place eight or ten years later, but both these strippings are too coarse for anything but rough use, such as making floats for fishermen's nets. From that time on each new layer of cork gets of closer and finer grain, and stripping takes place about every eight years until the tree gets to be 150 years old. The cork when cut rolls up into tubes the size of the tree from which it was taken. It is first pressed out into sheets, then boiled, and finally the rough crust of the bark is removed by scraping.

The uses of cork are numerous and varied. It is

chiefly known as a stopper for bottles, being especially good for that purpose, elastic, and impervious to water and other fluids. It is used for making life-preservers, being very buoyant; for artificial legs; and for making a moistureproof inner sole for boots and shoes, the ancient Greeks and Romans having used it for that purpose as well as people of today. The chips and scrapings of cork are largely used for packing purposes, particularly for fruit. Cork cuttings are also used to make the familiar linoleum which covers our floors, the cork being mixed with a preparation of linseed oil, fastened to stout canvas and colored in various patterns.

A BOTTLE OF INK.

Trees have always furnished materials to take the place of writing-paper, and in these days of wood-pulp paper they furnish still more; and a tree-growth helps furnish the ink with which to write on the paper. Common black writing-ink is made of an infusion of galls, copperas and gum arabic. Two of these ingredients, the galls and the gum, are obtained from trees. Nearly everyone has found twigs or leaves on which appears a rounded knot or knobby excrescence, a seeming deformity of growth. On cutting one of these excrescences open it will be seen to be the home of a small worm, which, by and by, will bore its way out and change into a winged insect. These insects are gall-flies, and the knobs are galls. The ones of most use to men are those found on oak-trees, and known commercially as "Aleppo galls" because Aleppo was formerly the center of the trade in them.

The female gall-fly lays her eggs in the tender shoots of the oak; the sap gathers round the wound, hardens, and forms the gall. The best galls come from Persia, Cyprus, Asia Minor and Syria, where the peasants regularly gather them for market. They are used for making ink and various dyes. The ancient

Greeks, Romans and other nations used them in the same manner. Another insect's egg causes a growth known as *kermes* in southern Europe and northern Africa, where they are gathered to make a red dye. There are many galls found on American oaks, but they are not gathered commercially, though rich in tannin and gallic acid. The pioneers used them for making ink and for dyeing black, just as they used the hulls of walnuts and butternuts to make a brown dye.

A QUEER USE FOR THORNS.

One of the tree-growths which has been used for many purposes is the thorn, thorns of all kinds; but perhaps the oddest use of thorns was made by the ancient Aztecs of Mexico, who punished bad children by pricking them with aloe thorns. Uncivilized men and women use thorns for pins to fasten garments, or for making holes through which to put their thread of twisted root-bark. The natives along the Amazon use thorns as heads for the tiny darts of their blow-guns, generally dipping the thorny point in a deadly vegetable poison.

Another prickly product of much use is the teazel, the dry seed-head of a variety of thistle. This fruit-head has long sharp spines on it, each spine having a hooked end, and they are used by cloth manufacturers to raise a nap on cloth, the teazels being drawn across the cloth so that the hooks of the spines catch and raise up the little wool-fibers, making what is called a "nap" on the cloth.

No altogether satisfactory substitute for teazels in cloth-making has been found, although many have been tried, among them a flat card of wood or iron, with wire points. Nature's machine, the teazel, still holds its own, however. The teazel-heads are fastened in a flat frame, which, in turn is fastened on a cylinder, which revolves one way while the cloth to be treated moves another. The cloth is pressed

against the cylinder, and the little hooks of the teazels thus catch in the loose wool, yet are not stiff enough to tear the cloth.

OLD TALES COME TRUE.

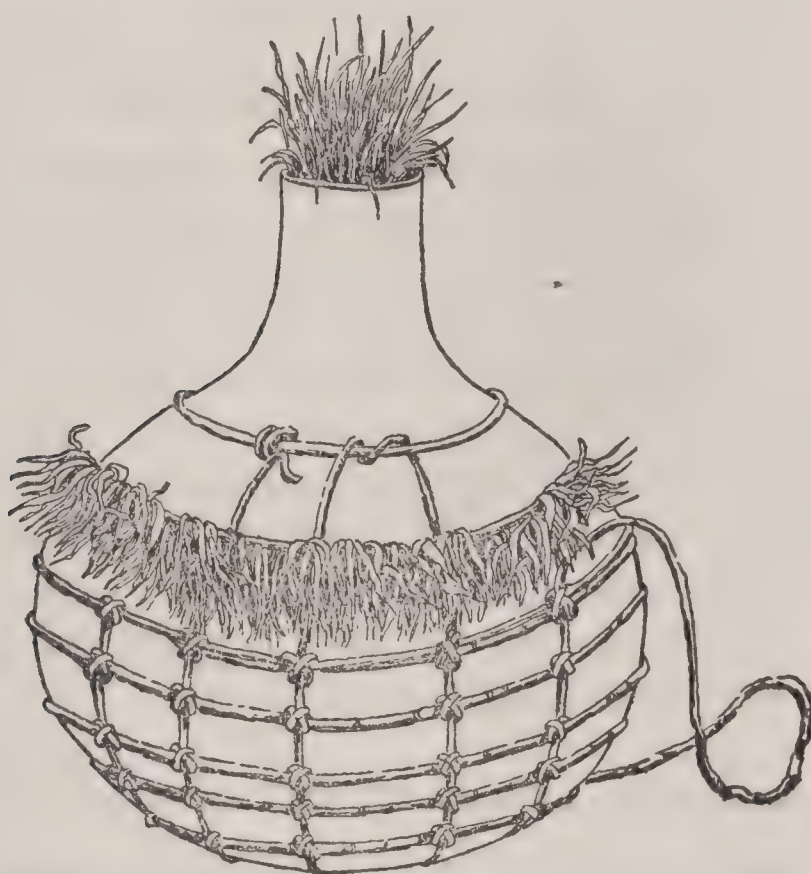
Herodotus, the Greek, "Father of History," who lived in the fifth century, B.C., told of a race of little men, pygmies, who lived in Africa and were seen by Hanno the Carthaginian, who sailed around the Dark Continent. Modern historians disbelieved the story, as they also laughed at Hanno's story of the gorilla, the "hairy men who lived in trees," until Du Chaillu and other modern African explorers, found not only the gorillas but the pygmies, too, and proved the truth of Hanno and Herodotus. Today the pygmies, or dwarfs, live in Africa, probably in much the same condition as they were in centuries ago. They make their little huts of branches, tip the darts of their blow-guns and their arrows with thorns, and wear a cloth made of the bast of trees, pliable and smooth. They dye this cloth gray-blue or reddish-brown, and some of it they trade to the tribes around them.

The Chunchos, who are a wild tribe of primitive men, scattered along the banks of the upper Amazon, also make bark cloth. These savages take large strips of the bark of the inachama tree and pound it with stones until the rough outer bark is removed and the bast is left smooth and flexible. Two large pieces of this rude cloth are then stitched together with twisted fiber, making a long sleeveless garment, reaching to the knees, and worn by both men and women.

BOTTLES FROM TREES.

Every country boy or girl knows how good a drink of cool water is when taken from the old gourd that lay beside the water-pail or by the edge of the spring. In the days before cheap tin cups the use of the dried gourd was far more common than it is now, but in

many parts of the world gourds and their counterpart, calabashes, are still important and useful domestic utensils. The common gourd of this country comes from a vine, but in the tropics they are replaced by the dried rind of the fruit of the calabash tree, or, in Africa, from the fruit of the baobab. Calabashes are cleaned of the inner, seedy pulp, and the hard shell



Sacred Water Vessel of Zuni Indians. Gourd Enclosed
In Wicker. (After U. S. Ethnological Report.)

is used for bottles, cups, lamps, dishes, snuff-holders and pails, the articles often being elaborately ornamented with various patterns cut or scratched into the shell and then colored.

Some years ago several of the priests and chiefs of the Zuñi Indians of New Mexico, were taken to Washington and then to the shores of the Atlantic Ocean, which is referred to in their tribal tradition, and where they held a religious ceremony. They took back with them, to be used in religious celebrations, bottles full of sea-water. The bottles they used were made of gourds, encased in wicker-work, which had

been brought from their far southwestern home for this express purpose, sacred vessels, many, many years old. In the Southern United States it is a common sight to see a row of gourds hung to a cross-arm on a tall pole, erected near a negro cabin, for birds to nest in. This use of the gourd was brought from Africa, where they are still used in the same way by certain tribes of the West Coast.

“RICE-PAPER” NOT RICE-PAPER.

Over in China grow two species of trees, from one of which is made the so-called “rice-paper” of the Orient, which, after all, is not rice-paper at all, but is made from the pith of one of these trees, cut into thin sheets by turning a cylinder of pith against the very sharp blade of a heavy knife. From the best of the other tree, the paper-mulberry, is made the curious “leather paper,” famous for its toughness and durability. Treated with oil this tough paper is used in China for wagon-covers and similar purposes, as tarpaulins are used in other countries.

WILLOWS AND SOME OTHER TREES.

The tough, pliable twigs of various species of willow-trees are extensively used in basket-making, the osier-willow being the best, and this is raised in large quantities in “willow holts” in Europe for this purpose. Its tough bast is used for making cordage and paper, and also yields dye-stuff. The North American Indians used the dry, chopped-up, inner bark of the red willow to mix with tobacco, for smoking, making what they called “kinnikinnic.”

The Pai-Utes of the southwest weave willow-bark into watertight baskets, and use them to cook food in, by dropping heated stones into a basket filled with water until the water is hot enough to cook the corn, acorns, or other food. Similar baskets are made by the Aleuts of the northwest coast out of the inner

bark of red cedar, and especially from the bark of the roots. These baskets are wonderfully woven and often beautifully decorated in symbolic, colored designs. The Indians used to make their own dye-stuffs from bark and plants, but now they largely use the aniline dyes made from coal-tar, not as beautiful, but easier to get and use.



A. Iroquois Vessel of Birchbark.
B. Zuni Woven Water Bottle.
C. Hauasupai Boiling Basket.

The pre-historic Cliff-dwellers of New Mexico and Arizona used the tough, fibrous bark of the yucca to make sandals and rude shoes, often lining the latter with corn-husks to make them more comfortable. The Indians of Central and South America make similar shoes and sandals today. The juniper, the pawpaw, the arbor-vitæ, the larch or tamarack, and the basswood, all furnish tough bark for the mats, baskets

and other articles made by the Indians. In Russia the European linden yields an inner bark out of which the peasants make bast mats, which are an important article of commerce, several million of them being exported every year.

DOSES SWEET AND BITTER.

John Josselyn, Gent., writing in 1675 *An Account of Two Voyages to New England*, says of the black spruce: "The twigs of this tree, boiled with honey or with the sugar of the maple-tree, make an excellent drink." This was spruce-beer as the Indians made it and as the settlers learned from the Indians. Josselyn also remarks that the inner bark of the hemlock, boiled

and pounded between two stones until soft, is used as a poultice or plaster; and that the cones of the balsam fir, "boiled in beer, are good for the scurvie."

Many medicines are derived from the bark of trees, the most important and best known being quinine, made from the bark of the cinchona-tree, a native of South America, but now grown extensively in India and other countries. The ancient Peruvians knew of the virtues of this bark in the treatment of fevers, and from them the Spanish learned it. The name "cinchona" was given the bark because the Countess of Chinchon, wife of one of the early Spanish vice-roys of Peru, was cured of a fever by it. It was also called "Peruvian bark" and "Jesuits' bark," because the priests of the Order of Jesus first introduced it into Europe. Quinine and other substances derived from cinchona-bark are the most valuable of febrifuges and tonics.

The medicine-men, "Shamans" or "Midis" of the Indians of North America knew the medical uses of many barks and plants, and this knowledge formed part of the secrets which were taught to the candidates for the calling. Among the great Ojibwa (or Chipewa) tribe a candidate was taken into the woods to be shown where to find and how to know the proper trees and plants. Before the bark is cut, or the plant, if small, is pulled from the ground, a smoke offering is made, and a small pinch of tobacco put into the hole that it left. This is an offering to Noko'mis, the earth, the "grandmother of men," for the benefits which are derived from the products of her body, the trees and plants and animals.

The names and properties of the plants and barks were kept on records of birch-bark, on which, also, were written the magic formulas to be uttered while administering the medicine, and many other things pertaining to the calling of a "shaman." One such record, known to be more than one hundred years old,

was in the keeping of an Ojibwa on the Red Lake reservation. It was seven feet, one and one-half inches long by eighteen inches wide, and was made of five pieces of birch-bark, neatly stitched together by means of fine strands of basswood, with thin strips of wood at each end to keep it from fraying or splitting.

A tonic tea was made from the bark of sassafras roots; medicine and poultices from the bast of slippery elm. The leaves and bark of the white and red pine, the white and black spruce, the tamarack and the white and red cedar were crushed and boiled and the decoction was esteemed as a cure for headache, backache and other ills. The gum of the balsam fir was used for colds; the bark of the red and white oak, the sugar maple and several other trees was made into medicine for digestive trouble; wild cherry-bark was good for coughs; and the cottony down of the cottonwood was used as an absorbent covering for sore places.

So the bark of trees supplied men with nearly all the necessities of life, food and clothing, fire and shelter, weapons and medicines, cradles and coffins.

CHAPTER XIV.

The Important Vegetable Fibers and Their Uses.

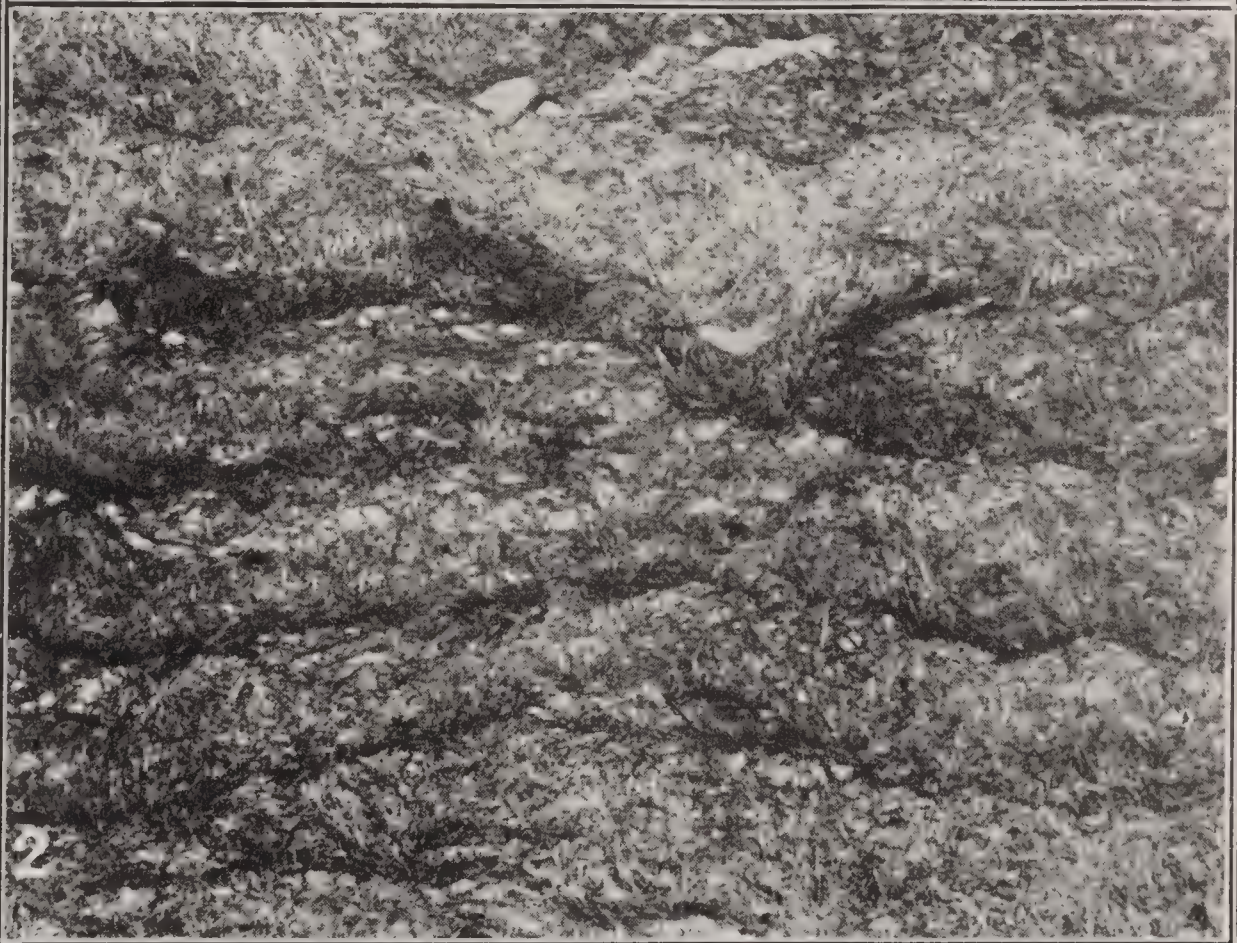
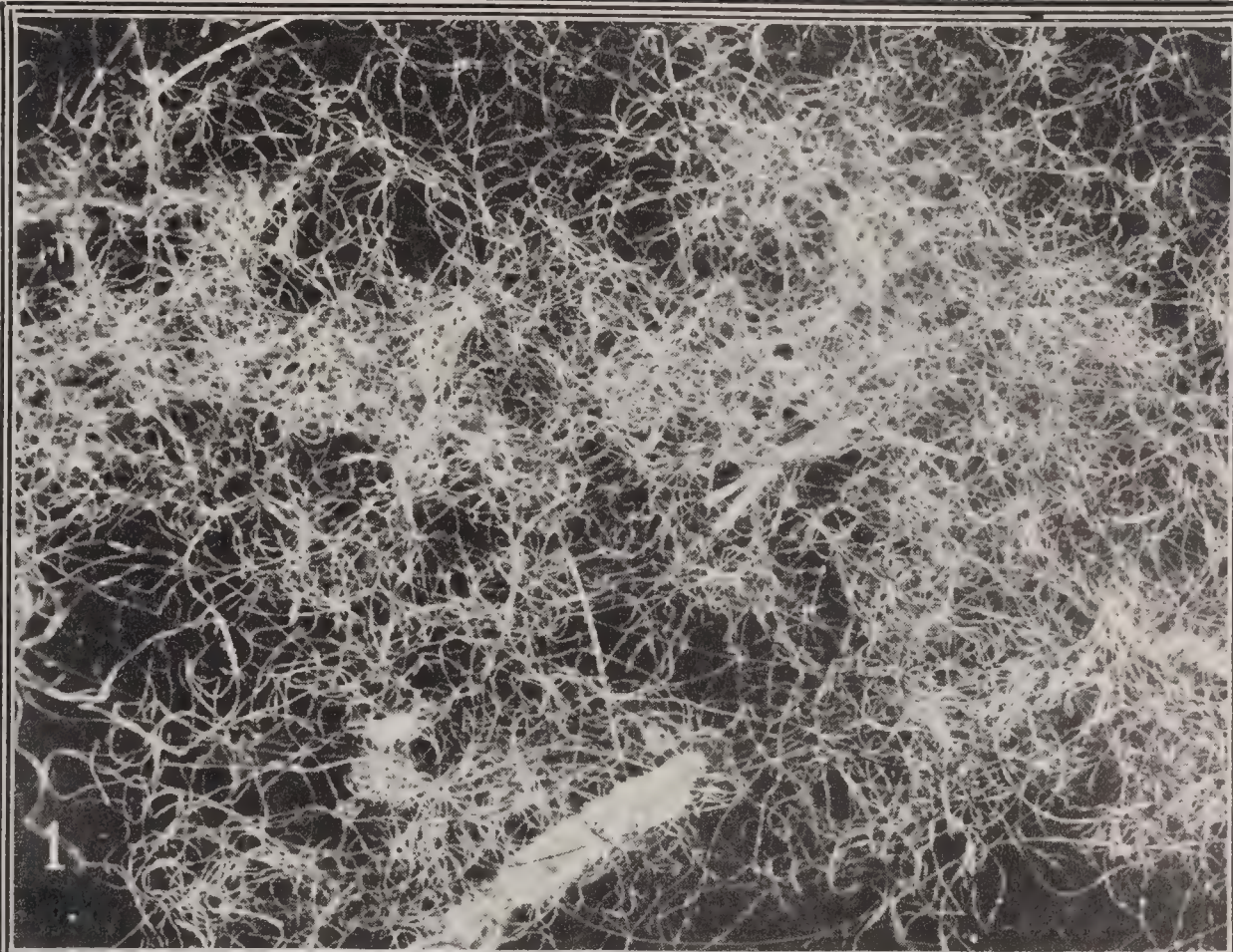
FIBERS IN PLANTS.

IF you will tear a piece of blotting paper, and examine the edges even by the unaided eye or, better, by the aid of a pocket microscope or a hand lens, you will see that the entire structure is formed of a mass of slender threads. These are fibers and have come from the plant from which the paper was made.

If you will go to an old rail, an old board fence or to an unpainted barn and carefully examine the rain-washed wood, you will see that some of the surface has been washed away and that a fine, fuzzy material has been exposed; that is the fiber of the wood. Hornets go to such places to gather these fine fibers, and from them make the paper-like substance that forms the outer coats and inside cells of their home. The nests of wasps and hornets are suspended in various places, the wasps' usually under protecting boards, the hornets from the branches of a bush or a tree. Both are familiar objects. Here we have the essentials of the whole story of fibers and their usefulness.

KINDS IN DEMAND.

Certain insects use fibers for protection; so does man. Insects discovered their importance; man has extended the field of investigation and is constantly gathering and devising methods of utilizing them, not only to make paper, but for cloths, clothes, and various other fabrics; for cordage, strings, ropes, yarn, and sewing-thread. The supply of fibers from old rails and old boards is enough to satisfy all the hornets and



1. Fibers of a fuzzy roll on the floor of an unswept room.
2. Paper of hornet's nest, from fibers of weather-beaten wood.

wasps in the vicinity, but even if such fibers could be used for all purposes by man, the supply would be much too limited for his needs. He, therefore, utilizes fibers from many different plants.

COTTON.

Perhaps the one in most common use is cotton, so extensively cultivated in the southern part of our country. The portions that supply the fibers are the seeds within the fruit known as the boll. These fibers are intended to assist in scattering the seed as are the silky tufts attached to the seeds of the dandelion and the milkweed or the feathery plumes of the clematis. Even these fibers, if they could be gathered in large quantities might undoubtedly be made useful. The cotton plant produces its tufts of fibers in masses so great that hundreds of pounds may be picked by hand in a single day. The dandelion head and the milkweed pod are less generous, and their fibers are much weaker than the threads of cotton. Experiments have been made with these and other fibers from the milkweed, but their advantage over hemp is so slight, and the expense of preparing so much more, that the experiments have been abandoned. The "silk" fibers of the pods are so smooth that they can not be used unmixed as they will not hold together.

The cotton-fibers are separated from the seed by a machine called a gin, or a cotton-gin, which drags the cotton through openings too small to allow the seed to pass. The seeds, by the way, are of great value for producing oil and also as a food for cattle. After the fibrous portion of the cotton has been taken from the seeds, it is baled and carried to the dealer or to the mill. The gin has not removed all the seeds, and perhaps leaves and parts of plants are scattered through the white mass; at the mill this foreign material or dirt is removed by passing the cotton through what is known as a lapper. In this machine it is torn

very fine, drawn through rollers and treated by various processes until it comes out in strips about an inch thick, three feet or more wide and many yards in length.

We are familiar with these in the form known as cotton batting. The cotton, after passing through many intricate processes, finally becomes fine thread, or a coarser and softer thread called "yarn," and from this the weaving into cloth proceeds. The thread is spooled and wound on great cylinders and also made into what is known as a warp for the loom. Sometimes there are very large numbers of these threads in a piece of muslin or other cotton cloth. If any one has a wish to know the number of threads required, let him count them in a piece of cotton cloth an inch long; then, multiplying by the number of inches in a yard, will show how many lengthwise threads are required for the width, and as the threads cross one another, and are in contact, it will be seen that the same number of threads must be needed for a yard in length.

The cotton for weaving is treated by various processes of boiling, starching, steaming, rolling, and drying. It is interesting to see the method by which patterns are woven in the cloth. The process is easy to explain but difficult to perform. Instead of using shuttles wound only with plain white thread as in ordinary white cotton cloth, there are many differently colored threads wound on separate shuttles. These different colors are obtained by dyeing processes. By the arrangement of the machinery one shuttle does its work and is then followed by others in the proper order to produce the pattern.

LINEN FROM FLAX.

Another important plant fiber is the flax from which linen is made. The thread desired is in the stem, and the method of obtaining it is therefore entirely different from that used with cotton, where the fiber is

in the fruit of the plant. When the flax stems begin to turn yellow, and the leaves within a few inches of the ground begin to droop, men pull the flax by handfuls and strike each bunch against their boots or a stone to dislodge the earth. The stems (or straw) are then laid in handfuls, crossing one another, so as to be readily made into bundles. In Belgium the flax is pulled with great care. Two poles are placed under the straw to prevent injury to the bottom layer by dampness. Most persons have seen sheaves or stalks of wheat piled up in this manner.

One of the problems of flax culture is to remove the seed without injuring the fibrous material in the stem. A common method at one time was to whip the flax against a sharp rock set at an angle of forty-five degrees. In some foreign countries the flax is still threshed by hand, but in America at the present time the plants are sometimes passed through an ordinary threshing machine; but this is generally done when only the seed is wanted, as it leaves the straw in bad condition. When the fiber is wanted, it is separated from the stalk by what is known as dew-retting. A moist meadow is selected and the straw spread over the ground in rows at the rate of a ton an acre. If this is done about the first of October, as is usual, two weeks will be sufficient to get the stem in such condition that the fiber can be readily separated from the other parts. In Ireland, the famous home of flax and of Irish linen, the straw is soaked in water until it ferments, when the fibers may be easily separated from the woody parts.

HEMP.

Hemp is similar to flax and is obtained from a tall Asiatic herb cultivated in many temperate parts of the world, and even in Northern Russia. The plant has an extremely tough fiber that is employed not only for making coarser forms of cloth but for cord-

age and ropes. Manila hemp is the fiber from a species of banana native to the Philippine Islands. This is utilized for matting, canvas and ropes; and the finer grades are woven into shawls and various native fabrics. Manila paper, made from this fiber, is familiar as ordinary wrapping-paper and a cheap grade of writing-paper. In fact, the name is so well known that it is often incorrectly applied to similar paper that is not really made from the Manila plant. With hemp, as with cotton and flax, the seeds are useful as food for caged birds.

SOME OTHER USEFUL FIBERS.

Sisal, belonging to the genus *Agave*, is a variety of hemp cultivated almost as widely as that of Manila because of its great strength and durability. The fibers are obtained from the leaves.

Jute is a strong fiber from the inner bark of a plant of the *Linden* family, and is used for carpets, canvas and bagging.

Esparto is a somewhat similar product from a grass of northern Africa and southern Spain. With it cordage, shoes, and baskets are manufactured. It is also used in making paper. All these fibers when used in paper-making are not really different from the material from which our hornet, with which we started in illustration, gets his supply. Perhaps one could easily imagine the yellow jackets (a variety of hornet) concentrating all their efforts on an old barn, while the wasps were working on the fences, both producing tissue similar in appearance, yet varying in texture, as will be seen upon close examination.

Coming to a material for coarser and larger fabrics, we have raffia, examples of which are readily seen in certain kinds of hats and more finely woven baskets. Raffia holds a place intermediate between the fine fibers of seeds or of stems or leaves, and the large, coarse reeds and rushes so commonly used in weaving Chi-



1. A. Pineapple Fiber. B. Flax. C. Ramie. D. Sisal. E. Manila Hemp.
2. The inner bark of the lace-bark tree; used for bonnets, collars, and other articles of wearing apparel.

nese matting or similar fabrics from Japan. It is made by cutting into slender strips the strong fibrous leaves of a palm grown in Madagascar. This method of production is similar to that of preparing the fibrous material from the leaf-stalks of various species of ferns. Some which are especially useful for this purpose are grown in Java.

THE SCREW PINE.

A great variety of fibers is obtained from barks, stems, and leaves of various plants grown in the East Indies. That most commonly used in this country is from the screw-pine, a genus containing more than one hundred species in the eastern hemisphere, and a dozen or more in the islands of the Malay Archipelago and vicinity. It derives its name not from any resemblance to a pine-tree, but from the spiral growth of the leaves and their general resemblance to those of the pineapple plant. Some screw-pines are so large that they are almost tree-like, but the majority are more or less bushy. The leaves are long, tough and leathery, and, with the roots, are the parts commonly used. The leaves are cut in large numbers, tied into bundles and carried by men to the village, where the prickles from the margins and under surface are removed by the women. Each leaf is first exposed to the fire, and is then cut into strips of a uniform width. These strips, after soaking in water for several days, are spread out and bleached in the sun. This makes them so flexible that they may be made into any shape without injury to the fiber. Large quantities of leaves of this type are placed together side by side, slightly overlapped, sewed together with a coarse fiber and made into large mats.

Coarse sacks are made of this screw-pine fiber and in them are shipped various articles of commerce sometimes found in our markets. To obtain the fiber from some of the many species, the stems are cracked,

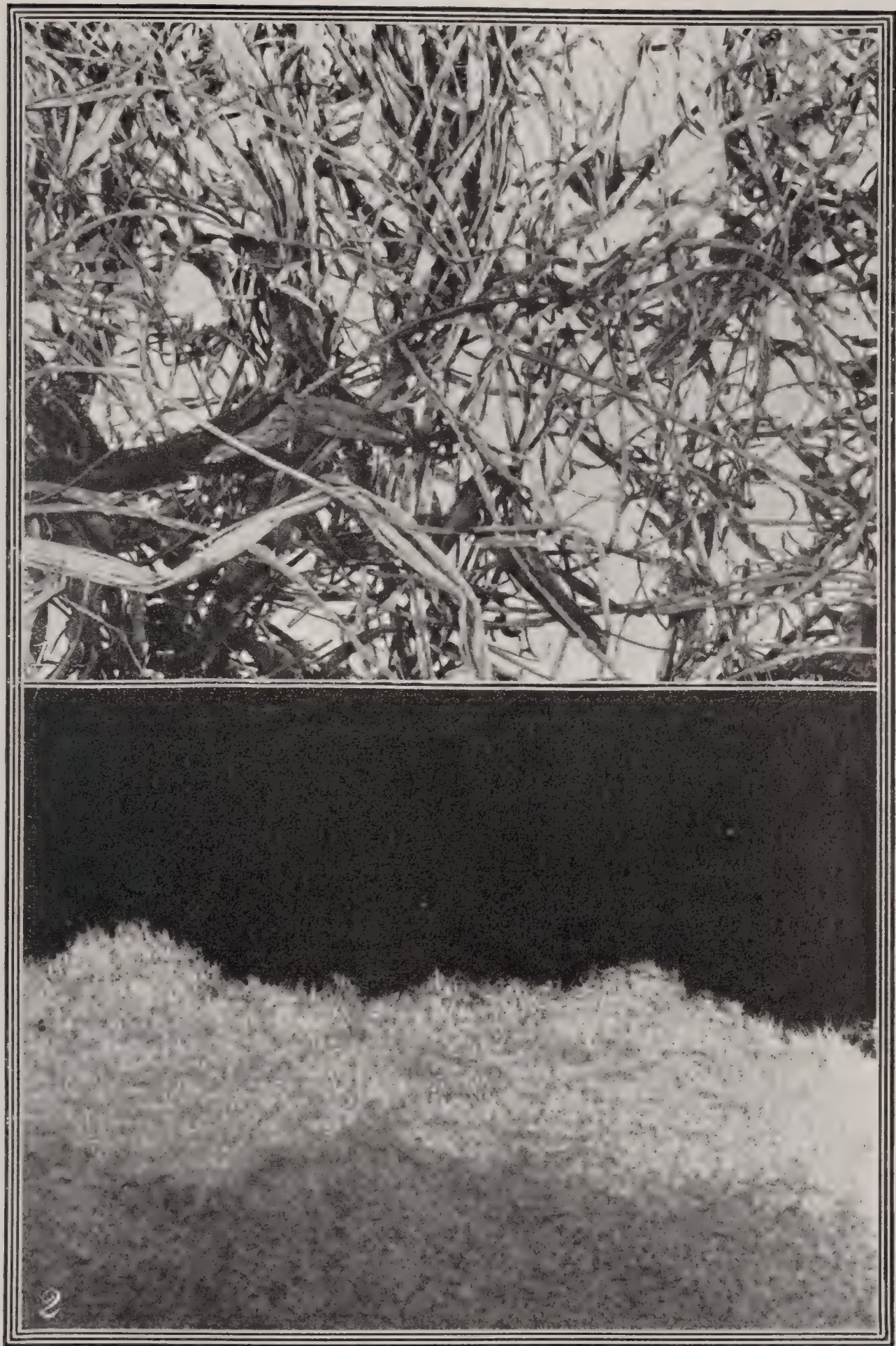
when the outer brittle part falls away. The central fibrous portion is scraped with a knife and split into small strips which are sharpened at one end and drawn through holes of diminishing sizes cut in a piece of tin. Fibers of this kind are used mostly for hats, which are worn by the Malay men at their festivals. Fern-fibers are used by the Hoopa Valley Indians, in northern California. The entire stem of the maiden-hair fern, and the dyed fibers obtained from the stalks of one of the chain-ferns are woven into hats, which are said to be the ordinary headdress of the squaws.

THE PALM FIBER.

Palm fibers are manufactured into many different articles and their use is common throughout the world. The husk of the coconut yields a tough, somewhat elastic fiber which is made into rope and into the more familiar door mat and coco matting. Probably the most elaborate and expensive of all these and similar materials is that used to make the beautiful Panama hat. This is finely plaited and is made entirely by hand in South and Central America from the young leaves of the jipijapa. A really good hat of the kind requires fully six months to complete and even at the low rate of wages paid in those countries the expense is great, when the profits of wholesaler and retailer, and the cost of transportation are added, one hundred dollars being a not unusual price. Those who can afford to own such hats are enthusiastic about them and say that they are as cheap as any other that will last as long. Such statements are probably more an outburst of enthusiasm than a statement of a fact. Most people, however, would prefer to have a new three-dollar hat every year rather than a three hundred dollar hat that might last one hundred years.

RATTAN AND RUSHES.

The coarsely woven cane seats and backs of chairs are made from a variety of rattan, a large climbing



1. Fibers of Calamus or Sweet Flag which is chewed into "Oakum" form by muskrats for making their nests.
2. Plant fibers in a torn piece of white blotting-paper.

palm of the genus *Calamus* to which also belongs the sweet flag of our marshes. The tropical calamus is stripped into slender pieces which are woven into wicker-work chairs, cane seats and even into cables for bridges. A plant similar in appearance to the sweet flag is the tall plant of our marshes known as the cat-tail, the leaves of which are used in the "rush bottom" chairs so often seen in old-fashioned farm-houses. A recent book on archæology pictures slippers made of these cat-tail leaves and found in an Indian tomb.

The use of still larger, broader and coarser fibers is in the making of chairs and baskets. For chairs the entire stem of the cat-tail is employed; for baskets the stalks are split and the wide strips, known as splints, are woven together. All these processes are practically the same as in the finer grade of cotton-weaving.

FROM THE HORNET TO MODERN FABRICS.

It is a long and varied journey among the useful fibers, when we progress from the paper-making hor-net that scrapes its material from the fence, to the savage with a cord of twisted reeds around his waist; to the half civilized man that wears a mat of plaited grass-leaves about his neck, with a hole for his head to pass through; and then to the refined and educated woman clothed in cotton, seated in a rattan chair, taking her embroidery yarn out of a raffia basket, to ornament a cotton fabric so fine and delicate that it may be translucent, and who brushes the dust from her slippers on a mat of coconut-fibers; it is a long journey but it need not be an imaginary one.

The man who weaves chair seats from grass blades has only discovered what the muskrat has known for ages. The muskrat realizes that the calamus and the cat-tail leaves contain good plant-fibers and he merely chews them up, in much the same way as the hornet chews the fiber from the old board fence, and makes a nest in his dome-shaped house under the water.

This calamus-fiber is not much different in appearance from the oakum made from flax and hemp and used in stopping up the seams of the sides of boats. The shreds of oakum before using are combed out and the word oakum is a corruption of a word meaning "combed."

There are also animal fibers as, for example, silk which the silkworm secretes, and wool that grows from the skin of a sheep. One advantage of the plant-fiber is that it is more easily obtained, and in most cases (excepting perhaps in high priced Panama hats) is not so expensive as are the products of the animal.

Many plants besides those here mentioned have been suggested as a source of valuable fibers, but experiment has shown that they are not adapted to cultivation, that the wild plants are too few to supply a probable demand, or that the expense and difficulty of extracting the fibers are too great. Many such experiments have been made and have been abandoned.

CHAPTER XV.

Vegetable Oils and Dyes.

OU are familiar with the characteristic smell of an orange or lemon. The more firmly you hold that orange or lemon to your nose, and the more vigorously you smell it, the plainer becomes this characteristic odor. If you will cut or crush a little of the peel you will get the odor even more strongly. With a sharp knife make very thin slices of the rind, and by holding it up to the light, you will find that it is full of tiny cavities. In these cavities was a liquid, an oil that evaporates rapidly, called the "essential oil," and that gives the skin its odor.

Other plants produce a great variety of oily products which are used for food, or in the arts or as medicine. Olives, cotton-seed, flaxseed, and various other seeds and fruits have each its characteristic oil.

LINSEED OIL.

That from flax is known as linseed oil and is the only available oil obtained from seed that will dry naturally. Poppy-seed oil will dry rapidly, but it can not be used as a substitute for the valuable linseed product, as it can be obtained in only rather small quantities, and as the expense of preparing it is great. This ability to dry rapidly makes the flaxseed oil of great value because, while it is oil in form and composition, and has the effect of oil, yet in this peculiar character it is unlike other oils, with the exception already mentioned. For this reason it is used mixed with various finely ground inorganic materials as, for example, lead and other substances, to form paint. It is also utilized in the manufacture of varnishes, and,

when mixed with certain solid materials, to prepare oilcloth and linoleum.

Of late years the annual crop of flaxseed in this country alone has been about twenty-six million bushels, the greater part of this having been raised in Minnesota and in North and South Dakota. It is also used in printer's ink because it dries rapidly.

COTTON-SEED OIL.

The oil of the cotton-seed does not dry like linseed oil, but it has a greater variety of valuable uses. It is made from the seeds after the hulls have been taken off by machinery. The "meats" or kernels thus obtained are heated for several minutes, after which they are packed in haircloth and subjected to a pressure of four thousand pounds to the square inch in a hydraulic press. A ton of seed contains about fifty gallons of oil, and this oil is now produced in larger quantities than any other vegetable oil. It is used for cooking, as a salad oil, as a substitute for lard, instead of olive oil in certain medicines, and to preserve sardines. It also makes a soap which is especially useful for washing wool. The familiar "cottolene" is a mixture of cotton-seed oil and beef fat.

OLIVE AND RAPE-SEED OIL.

Olive oil is pressed from the fruit of the olive. It is used as a salad oil, in cooking, in medicine, to make Castile soap, as a lubricant and in various other ways. Some is made in California, but the greatest quantity and the best is imported from southern Europe. Much that we receive is adulterated with peanut oil or with cotton-seed oil. The oil from rapeseed, the rape being a plant allied to the common cabbage, is extensively used in France and in England for burning in lamps. The plant is cultivated for the sake of its oily seeds, which are also acceptable to sheep and pigs as food.

POPPY OIL.

Poppy oil has none of the narcotic effects of opium, although it is pressed from poppy seeds. It is made extensively in Europe, and is much used by soap-makers and in some varnishes. Artists utilize it in mixing their colors, as it dries rapidly. The amount made is too small and the price too high to allow it to be used as freely as linseed oil, although it has great drying qualities.

OTHER VALUABLE OILS.

Oil of mustard, which also evaporates rapidly, is made by applying heat to the seeds of black mustard. It is exceedingly acid, and so pungent that a smell of it brings tears to the eyes. It acts on the skin like a blister. It is used to some extent by physicians.

Palm oil has an orange color, is thick as butter and has the odor of violets. It is made by boiling the kernels of palm nuts and skimming the oil from the surface of the water. It is used in the making of fine candles and in some soaps which retain the pleasing odor of the oil.

The almond is one of the most ancient of fruits. It is mentioned in the Book of Genesis. It contains two kinds of oil, one of which is obtained by strong pressure, the other by boiling the almonds in water after the first kind has been extracted. It contains a deadly poison (hydrocyanic acid), and is used as a medicine.

The flat, greenish gray seeds of the fennel have a pleasing odor and taste, and are often, in Germany especially, strewn on the surface of cakes and bread to give them that flavor. The volatile oil is used in perfumery, in soap-making and occasionally as a medicine.

Oil of pennyroyal is obtained from the seeds by boiling in water. It has a strongly aromatic odor, is yellow in color, and is sometimes used as a medicine.

It is also valuable because its odor is unpleasant to mosquitoes.

Oil of peppermint is extracted from the plant by boiling in water. When first prepared it is colorless but becomes greenish with age. It has a hot, pungent taste, followed by a peculiar coolness caused by its rapid evaporation as the breath is drawn in, or after swallowing water. It is used as a flavoring extract and in medicine.

Oil of theobroma, often called cocoa butter, is obtained from the seeds from which chocolate is made, and is often seen floating like oil on hot chocolate as prepared for drinking. It is ordinarily a white solid, looking much like tallow, and has the pleasing odor of chocolate. It is used by druggists in ointments and cosmetics, being obtained from the seeds by pressure.

Amber is a fossil gum-resin found near the Baltic Sea and in the north of Asia. It is supposed to be the exudation of an extinct tree belonging to the *Coniferæ*, of which our pine-trees are members. Oil of amber is made by distillation. It is yellowish, transparent, and has a sharp, peculiar odor. It is used by the druggist in some of his medicinal preparations.

Tobacco oil is made by distilling the tobacco plant which then gives off a thick, black liquid, smelling like an old pipe. It is a deadly poison. The oil from the seeds is sometimes used in making varnish.

Birch oil, from the bark of the white birch (*Betula alba*), is used in the manufacture of Russia leather, and gives it the characteristic and pleasing odor we all know so well.

Croton oil, a violent poison, is obtained by pressure from the seeds of a small tree growing in India. It has an unpleasing, sickening odor, and a hot, sharp taste. It is used in medicine.

PLANT DYES.

Most young people are familiar with the bloodroot. This plant has beautiful white flowers and takes its

name from the fact that the root contains a reddish juice somewhat resembling blood. It is said that the Indians used this juice as a war-paint to color their faces.

Many plants thus directly produce a coloring material. This is especially noticeable in the juice of various berries as, for example, blackberries, poke berries and many others. There are other plants that produce a coloring material from the juice.

Indigo as a color does not exist in the indigo plant that grows in India, but the extract takes its blue color by the decomposition in water of the substance known as indican.

Logwood is a red material that is obtained from the heartwood of a Central American tree, containing a principle known by chemists as haematoxylin and is much used for dyeing various fabrics.

Fustic is a similar dye obtained from a tree in Mexico and the West Indies. It produces a light yellow dye much used in the arts.

Madder is from the root of a European herb and is used in dyeing red. Other colors, madder purple and madder orange, are also made from it.

Sumac produces a coloring material and also a material used in tanning leather.

GALLS.

The growths known as galls on leaves and twigs and plants are caused by the stings that insects make so as to deposit their eggs within the plant. From some of these galls are made dyes, but they are not plentiful enough to be used extensively.

THE COMMONER PLANT EXTRACTS.

Extracts are made from plants. The most familiar perhaps is sugar. This is prepared from the crystallized juice of the sugar-cane and also from that of beets. The delicious maple-sugar is obtained from the sap of the hard maple, often called the rock-maple

tree. The sap is taken from the tree early in the spring, long before the snow is off the ground. A hole is bored in the trunk, and a hollow spout of hard wood is inserted, the spout being commonly known as a tap and usually made by pushing out the pith of an elder stem. The exuding sap is allowed to drip into a vessel, from which it is transferred to a shallow vat in which it is boiled. The sugar is usually brownish in color, and has a delicious flavor not possessed by any similar vegetable substance. Large quantities are made in New England, Michigan and in some other of our northern States.

TURPENTINE.

In the arts, turpentine is used extensively and the method of obtaining it is similar to that of obtaining maple sugar. The pine trees are tapped by cutting off the bark on the side, the oily sap running out into earthen cups or buckets. From this sap, by proper treatment, are obtained our common turpentine, resin or rosin and various other products.

RUBBER.

This substance is what may be called a secondary one in the form in which it finds its greatest use. While it is true that many natural products must be more or less changed, yet some require so entire a change as to make them virtually new substances with new properties—such as the metals, pottery, and glass. A few metals are found nearly pure, but the most important of all, iron, is found abundantly only in an ore that must be skilfully treated to secure the metal in useful form. Pottery is made by very skilful treatment of various clays whereby a soft, breakable substance through which water will pass is changed to a hard, fire-resisting and water-holding material—a material almost indestructible. Glass is not a natural product, save in a few accidental cases, but a most

ingenious combination of several natural substances.

Rubber, in its natural form, could have but few uses. It was a gum, very hard and elastic it is true, compared to others, but softened by heat and reduced to a brittle state by cold. Out of this, by adding a mineral, and by the use of heat, men have learned to make what is truly a new substance, having so many uses that today we see the price of the raw rubber constantly rising and the world sure to face a rubber famine in a very brief time unless men shall make the rubber-plant a regular artificially raised crop.

The changing of the hard, black masses of crude rubber into the soft and often beautiful objects with which we are familiar is a complex process demanding much care and the use of many and varied chemical preparations.

Many years ago what we now call rubber was given its native name, "caoutchouc," a word taken from the language of the Indians along the Amazon River. It came into notice as early as 1735. When it was found out that this substance would remove pencil marks, people came to speak of it as "India rubber," the word "India" simply meaning foreign, since not all rubber came from Asia, but from a belt of land situated at various points around the globe, within 30 degrees south of the Equator. The milky juice of a number of trees and plants will harden into rubber. Most of it, however, now comes from along the Amazon, where the great trees, seventy to a hundred feet in height and five to seven feet around, grow amid the dense forests. The trees are tapped in the morning, and during the day a gill of milky fluid flows out. A cup, usually of clay, is placed below the cut to receive the milky juice. When enough has been obtained, it is poured on clay, or a paddle tipped by a clay ball is dipped into it, and dried, usually over a smoky fire, successive layers being added and dried until a lump of the desired size is made. The juice dried in the sun

is white within, yellowish-brown outside. The smoke gives to the crude rubber the black color which may be seen at any rubber mill. The pure juice is nearly colorless.

The best variety is known as the Para rubber, prepared over open fires. Other kinds are taken from trees cut down for the purpose, or from a vine or creeper.

The first lumps of rubber brought to America were bottle-shaped, and were considered only as a curiosity. In 1823 the first pair of rubber shoes was imported, and two years later, five hundred pairs made by the Indians near the Amazon were readily sold at from three to five dollars a pair in Boston, and many hundreds of them, clumsy and awkward as they were, continued to be brought every year.

An article published some years ago in the *Philadelphia Record* gives an amusing description of the shoes made at Roxbury, Massachusetts, in 1833: "They really bore no resemblance whatever to a shoe. They had the appearance of having been run into molds, or blown, the same as glass bottles are made. They were made of pure rubber gum. No attempt was made to imitate the shape of the shoe or foot they were intended to cover. In shape they were hollow tubes, tapering toward the toe. At the place where the opening to pull them over the shoe should be was an irregular hole, without shape, just as they came from the mold. The hole was enlarged with a pair of shears to fit the instep, or cut high or low to suit the taste or caprice of the customer. The work was done by the salesman after the buyer had selected, according to his requirements, heavy or light, thick or thin. Men's sizes were very heavy, the soles being frequently from one-fourth to one-half an inch in thickness. They were tied in pairs and stuffed with straw or hay to keep them in shape for shipment. A lady's foot incased in such a huge, ill-shaped mass of india

rubber gum, weighing at least a pound, presented a clumsy appearance, indeed, particularly when compared with the light and truly artistic appearance of the present styles." And these queer articles melted in warm weather, while in frosty weather they became hard and brittle. But in the year 1839, the American inventor, Charles Goodyear, after years of experiment that reduced him to want, devised a way of using sulphur to harden rubber so that it would not soften at a moderate heat nor become brittle when chilled, and the india rubber shoe began to assume beauty of proportion and practical utility. They were lasted, and the shoe merchant threw aside his shears. One particularly popular style that had a great run for a couple of years was trimmed with fur around the tops, and came well up on the ankles. Dickens has immortalized this particular style by placing them on the feet of the pretty Arabella that Mr. Winkle met and fell in love with while visiting Mr. Pickwick at Old Wardle's.

All rubber shoes were made from the solid gum at that time, and we are safe in saying that a single pair would outweigh six pairs of those now in the market. Besides being heavy and ugly, they were often painful from being so tightly stretched over the foot. They made the wearer look club-footed, and any attempt at embellishment was a failure and made them appear clumsier still. But this condition of things was not to last. In 1844 Goodyear perfected his vulcanizing process, and his method of spreading the pure gum upon elastic textile fabrics, and the manufacture of rubber shoes has since improved from year to year, until they have become a thing of beauty.

Later, Goodyear discovered that by treating the substance with different amounts of sulphur he could vary its hardness to almost any degree, from that of the elastic bands now so common, to that of the hard substance first known as vulcanite, or ebonite, from which could be made such articles as combs, pen-

holders, knife-handles, buttons, and, in fact, a hundred articles formerly made of horn, bone, ivory, or jet. The vulcanized, or sulphur-treated rubber could be melted, cut, carved, and polished.

Soon afterward, American companies had begun to manufacture, under the Goodyear patent, shoes, gloves, waterproof clothing, and elastic bands were introduced and eagerly accepted by the public. The new industry grew rapidly, and from 1860 to 1870, rubber manufactures increased in value from less than a million to eight millions of dollars.

There seemed no end to the uses for the new substance. Railroads used rubber packing and hose, factories used belting, rubber tires were put upon wheels, rubber-mats were made not only for doorways, but in small sizes for the table and the counter. To give an idea of the manufactures today, we shall simply give, briefly, the mere names of articles, each of which consumes enormous quantities of rubber: rings for preserving-jars; pencil erasers; billiard-cushions; rubber-stamps; balls used in games; waterproof clothing, blankets, cloths and cases; elastic gores for shoes; many druggists' wares; air-pillows; atomizer bulbs; elastic bands of every size; corks and plugs—all these are simply articles of the soft form of rubber. Among hard-rubber articles we may name electrical appliances; combs; syringes; pipe mouthpieces; buttons; ink-wells; pen-holders; rulers. And any one could by a little thought easily add plenty of items to both lists.

The United States imports yearly over one hundred million pounds of rubber, valued at over one hundred million dollars and manufactures articles of this material to the same value.

It will be seen from this hasty sketch that a volume might easily be given to describing even a small part of the important industries which owed their rise to the discoveries of the American inventor, Charles

Goodyear, and of those who have since developed and improved the process he discovered. The enormous demand for rubber at the present day takes at high prices all that can be produced, and keeps men at work to discover new sources of supply or to devise substitutes that can be made from the juices of other varieties than the few now employed in the production of rubber. And it is impossible to realize the benefits to mankind in health and comfort arising from the uses of this hardened sap of the tropical tree.

GUTTA PERCHA.

This is a substance much resembling rubber in its qualities though from another tree, and is used for similar purposes. It is especially valuable, however, in not being affected by salt water, and in being a non-conductor of electricity. It is therefore necessary for the covering of sub-marine cables, being the best substance for the purpose, and hardly to be replaced by any other. At first, gutta percha was collected by cutting down the trees that yielded it, and consequently great waste resulted; but more recently it is collected by tapping the trees. It is less elastic than rubber, softens when warmed, and hardens in cooling. It is better adapted to some few uses than rubber, but is not so generally used, being found best as an insulator in electrical appliances, in making handles for surgical instruments and knives, and for waterproofing cloth. It differs from rubber by softening when heat is applied, and hardening again without becoming brittle. India rubber, when warmed, does not become plastic, and when softened, becomes brittle on hardening.

WHAT GUM IS.

The word "gum" is used neither carefully nor exactly. It is applied to a great many different substances, whatever their origin, with the meaning that they are neither quite hard nor quite liquid, and yet

may be either softened or dissolved in water. When slightly softened by moisture they may either swell up and become larger and softer, or they may dissolve entirely, thickening the water into a liquid that flows less readily and that leaves a deposit when it dries. The word gum is applied either to the hard substance or to the thickened liquid formed from it.

When we speak of natural gums produced by plants, we mean masses of the sap or other juices that, containing considerable water while in the plant, lose some of this by drying, and so become gum-like in form. A very common example is the cherry-gum, found in the bark of cherry-trees. As we all know, this may be either very soft and jelly-like, or it may be dried into a hard, almost stone-like, substance.

GUM ARABIC.

There is a very long list of true gums and of substances like them which have become known by the same name. One of the most familiar to us is the common gum arabic. This is gathered from the acacia tree, different kinds coming from various species and having various values. The reason why gum arabic is so called is because the gum came originally from Asia, through the Red Sea, to Egypt, whence it was shipped to Europe. But as acacias grow in a wide belt of regions, both north and south of the Equator throughout the world, the gum now comes from many different sources, being named according to the country it comes from.

The gum comes out from wounds in the bark, in lumps from the size of a pea to that of an egg. It is good to eat, and those who gather it eat a large part of the crop. Being harmless to the system, it is much used in medicine, stronger drugs being mixed with this milder substance. Whether it is really a food that nourishes is disputed.

As gum arabic is very sticky and dries readily, it has been used from early times to make mucilage, and

also for use in painting in water colors, to which it gives thickness and gloss without changing the color. When it is desired that the gum should dry without cracking, a little sugar, glycerine, or gum tragacanth, is mixed with it, and to keep it from decaying, various essences or a few cloves are used to keep away or to kill the microscopic forms of life that would cause it to spoil. Besides these uses, like other gums it is used in stiffening cloths or in giving them lustre.

Gum arabic is so generally useful that it may be taken as a type of useful gums. In general we may say that the main use of gums is in thickening liquids, fastening things together, forming a waterproof coating, fixing dye colors so that they will not run, and sometimes in making substances more easily soluble in water.

A peculiar thing about gums is that the true ones are what is known as "amorphous," that is, they separate into formless lumps or have no fixed shape, either in particles or in the whole form. Starch, on the contrary, has a regular form of particle, rounded or bud-like. Sugar and salt, when dissolved and allowed to dry, form into crystals, but a little gum when dissolved will dry into any shape it happens to be left, and has neither crystals nor structure. It is this fact that makes it so strong an adhesive, as it fills up cracks and rough surfaces, and then dries into a hard substance.

GUM TRAGACANTH.

This gum represents another class of substances. When water is added to it, instead of dissolving, it takes up the water and swells, puffing up somewhat as tapioca does. It is used in cloth-printing and in medicine, and also as a mucilage.

CHERRY TREE GUM.

This forms a thick mucilage, with water, and is not equal in value to either of those mentioned,

GUM RESINS.

These are not true gums, having mixed in with their gum part other substances that will not dissolve in water. They form a harder substance when dried, and may be even brittle. Though somewhat used in medicine and to make colors, they do not take the place of the true gums.

CHEWING GUM.

Chewing-gum may be made from a number of substances, but the substance best adapted for it is known as chicle-gum, which is obtained from a tree in tropical America called the naseberry. In order to make it taste good, sugar and various flavors are added, after which it is dried and shaped into convenient pieces. Recently a member of Congress stated that in a single year twenty-five millions of dollars were spent upon chewing-gum in the United States alone. For this there are two reasons. The pleasant taste makes it as welcome as candy, and also causes the mouth to give out saliva. Many people do not chew their food enough, and consequently do not exercise their jaw muscles, which makes the chewing of gum agreeable. The second reason is the force of habit. The chewing is started on account of the pleasant taste, and then, like any repeated action, is continued thoughtlessly. The habit is exceedingly bad, because it tends to bad open-mouthed breathing, exhausts the salivary glands by overwork, and is exceedingly ugly. Those who properly chew the starchy foods will find that they have no wish for chewing-gum, and those who have any respect for their own good manners, and will notice how unpleasant the sight of one who is addicted to this habit may become, will certainly not contribute to the twenty-five millions a year already mentioned.

OTHER SUBSTANCES CALLED "GUMS."

Among the substances which are not properly gums, although so called, are copal, which is used in



1. Gum Chicle: the naturally thickened Gum of the Sapodilla Tree from which Chewing Gum is made.

2. The Vessels used to catch the Sap of the Trees, and the Palm Fruit used to make the Fires over which the Rubber is cooked and smoked.

making varnish; magilp, a medium for oil painting; mastic, used somewhat like copal. These are not properly soluble in water, having to be dissolved by alcohol, or spirits, and are not therefore rightly called gums.

The cone-bearing trees produce several kinds of gums and resins. Thus the balsam furnishes the rich, transparent "Canada balsam," a substance that is used in medicine; and, because it is so transparent, it serves to fasten together the different pieces of curved glass that make up compound lenses in microscopes, telescopes, and cameras. Microscopists also mount objects on glass, fastening over them thin cover glasses by means of a drop of Canada balsam. This is an excellent adhesive, and also preserves the object from injury or decaying. Like other resins, it may also enter into the make-up of varnish.

SPRUCE-GUM AND GUM CAMPHOR.

From the spruce tree is obtained the well-known gum that was used for chewing long before there was any chewing-gum put on the market. The best sort comes from the white spruce, though the other varieties also furnish gums little inferior. In America, spruce-gum is worth from seventy-five cents to a dollar and a quarter a pound. The natural gum is boiled or melted down, the impurities removed, and a little paraffine, resin and sugar added to make the spruce gum that is put on sale. The most valued gum is that which is found in lumps, not that which gathers in seams in the bark.

We often hear of gum camphor, but it is not as a gum that the camphor occurs naturally, at least not on the outside of the camphor tree. Ordinarily, the camphor is obtained by heating the wood and distilling out oil. This oil, when it turns to crystals, forms the masses called gum camphor. In Borneo there is a camphor-tree in which, when the tree is split up, the

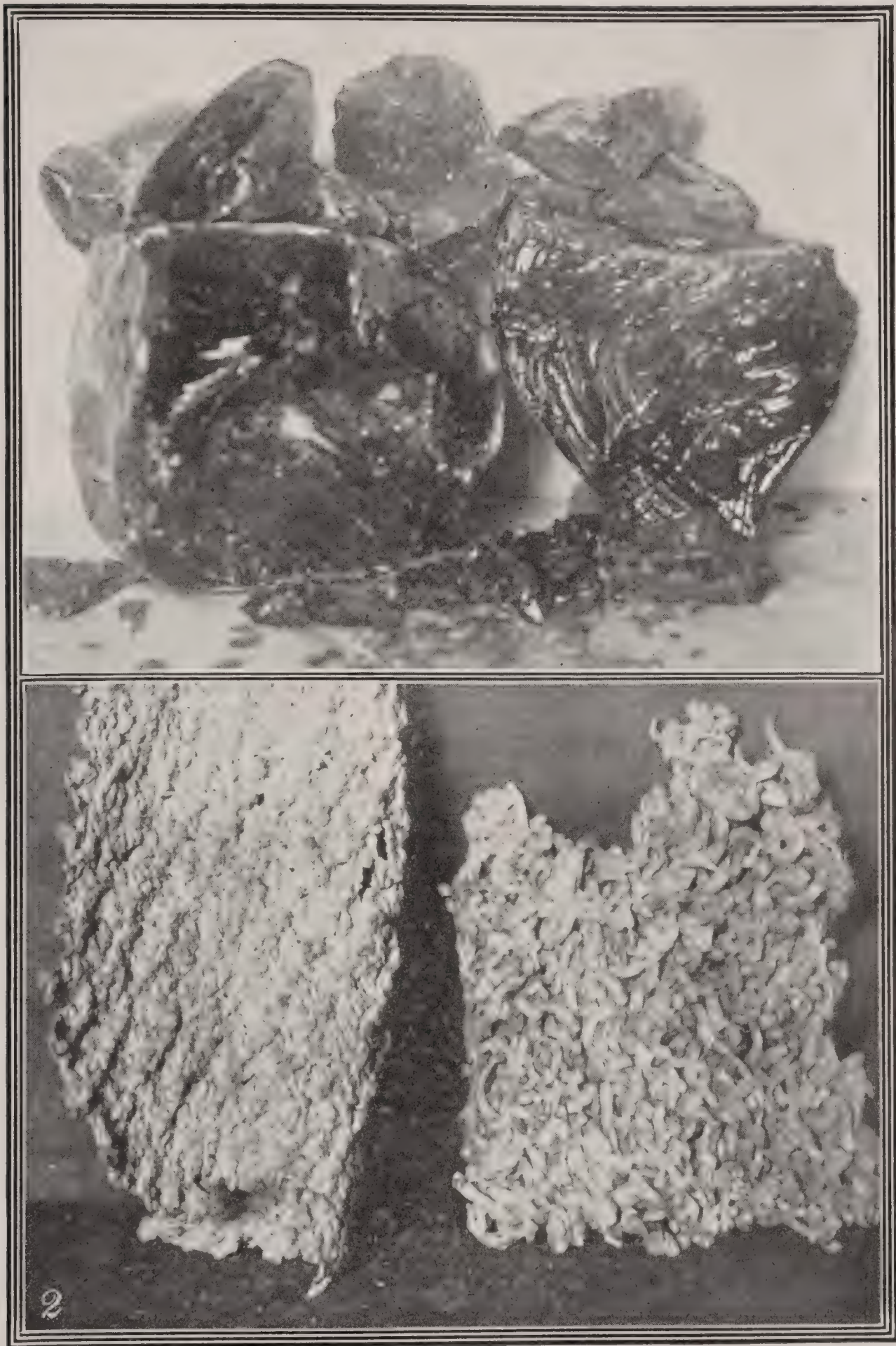
camphor gum may be found in layers among the wood fibers. It needs no refining, and being so pure, is used in religious ceremonies among the Orientals, especially in funeral rites. It burns very readily, giving off an odorous vapor.

Camphor is in very great demand throughout the world, being valuable as a medicine, as a protection against insects, and in several manufactures. In order to control the product, it is said that the Japanese government recently spent large sums of money, hoping to get possession of all the plantations, or enough of them to control prices. But the merchants who had dreams of securing wealth by this monopoly did not reckon with modern science. When it was found that the price of camphor was rising in the market, the demand set some of the ablest German chemists to investigate the making of camphor artificially in their laboratories. Their work proved to be entirely successful, and the monopoly which the Japanese had dreamed of securing proved to be valueless, since it was found that camphor could be made out of several cheap materials anywhere in the world, and no one was therefore dependent upon the natural product. An account of this victory for the chemists will be found in *Harper's Magazine* for February, 1911.

The soot from burning camphor is exceedingly black and fine grained, and it is believed that it is used in making "India ink" or "Chinese ink," though no one seems able to make the India ink sticks equal to the Chinese ink. When the ink is dissolved in water, there is a camphor-like odor given off.

RESINS, PITCH, AND TAR.

Resins are distinguished from the gums by the fact that they will not melt in water, but must be dissolved in alcohol. From the cone-bearing trees, as we have mentioned, comes crude turpentine, which, when it is boiled down, gives the spirits of turpentine and leaves



1. The Resin remaining after the distillation of Turpentine from Long-leaved Pine.
2. The concrete milky exudation of the Para Rubber-tree.

the ordinary resin such as is used for making varnish, sealing-wax, in some soaps, and kinds of paper. If the resin is still further distilled, it will leave behind it pitch.

If the wood of these trees is burned in a pit where little air can reach the fire, the wood burns without flame, slowly, and gives out tar. From tar creosote can be extracted. The main use of these products comes from the fact that they will not dissolve in water, and so may be used in making varnishes, lacquer, roofing, pavements, and for mixing with various substances to cause them irresistible to dampness.

Of course there is no attempt made to give a list of the hundreds of minor uses of these substances, as the use of turpentine in medicine, by painters to dissolve paint, by printers to remove ink-stains, and to dissolve many substances, and of resin upon the bows of violin players, and by plumbers in soldering. Creosote is widely used to keep wood from decaying, and was once used in medicine for antiseptic purposes for which it is now replaced by carbolic acid. Here, again, we may say that these commoner resins may be taken to show us the uses of different varieties brought from foreign lands. The general purpose is the same, though some varieties are better suited to one use than another.

PERFUMES.

Various plants have not only in their fruit but in their flowers an oil or other liquid matter that is delightfully fragrant. Scientists say that the possession of this odorous oil is an evidence of selfishness on the part of the plant, because the perfume attracts certain insects that help to spread the plant by carrying pollen from the flowers of one to those of another. It is said, too, that the pleasing odor of many fruits is to attract attention so that they may be eaten and the seeds scattered. What we call perfumes are agreeable to every one, and although they may finally

benefit the plant, they at the same time give men, and especially women, much pleasure through the sense of smell. On account of this fact the manufacture of perfumes has become a great and profitable business. The number and variety of these delightful essences are wonderful. Many of these are familiar, and bear the name of the plant from which they are made; for example, hyacinth, heliotrope, rose, lilac, violet, sweet pea, geranium, lavender and many others. Among those not so well known may be mentioned linalol, from the lily of the valley; mandarin oil, from the peel of the mandarin orange; mignonette; tuberose, from the fragrant flowers of that name; grapefruit; wild ginger; champaca, from the flowers in Manila, and said to have "an incomparable fragrance."

More than one kind of perfume may be taken from the same flower. In some plants the perfume changes almost with the hours of the day. For that reason we often hear disputes about the perfume of certain flowers. Kerner and Oliver in their book, *The Natural History of Plants*, say as follows:

"Not unfrequently one hears wholly different opinions about the scent of a flower. One observer thinks it to be vanilla, perhaps, another a violet scent. Both may be right, since two kinds of scent may be actually liberated from the same flower, whilst individuals are frequently unequally susceptible to all odors.

"The difficulties of identifying the flower scent are also increased by the fact that a certain amount of imagination is almost unavoidable. Taste and sight may also be at fault. On looking at a carnation one is immediately reminded of the smell of cloves before the scent has actually reached the nose. It is therefore advisable that the flowers should not be seen while their scent is being identified, and that to examine them one should get a friend to hold them before one's nose after one's eyes are shut."

The odorous blossoms from which the perfume is to be extracted are exposed in several layers to some pure and inodorous fat, which absorbs the fragrant vapor or oily exudation. When the fat has absorbed all that it is able to receive, it is treated with alcohol, or some other fluid proper for the purpose, and the fragrant odors it has absorbed are obtained free from the grease, and after further treatment is made into the scents ready for our pleasure. Perfume-making is more fully told of elsewhere in this volume.

PART II—Continued.

Section 3.—Comfort and Pleasure.

CHAPTER XVI.

How Love of Plants Grew.

THE EARLIEST HOME OF MANKIND.

IN trying to tell where mankind first lived, we are of course speaking not of man as we know him today, but of the ape-like, man-like creature that was, in the course of long ages, to be improved into man. We can only judge what these first creatures were by the fact that men were at one time (if considered only as animals) very like the great apes. Such apes now live, for the most part, in the forests. They are fitted in every way to live most comfortably where there are trees among the branches of which they can find the fruits that are their principal food, can secure perches in which they are safer from the great animals of prey and from serpents or other dangerous creatures that for the most part keep near the ground.

If we seek to go further back than the life of apes, and come to the smaller creatures of the kind, we shall find them even better fitted to live among the branches of the forest, seldom or never coming to earth, able, by means of their long arms, to swing their bodies across wide places, and to catch safely the spreading boughs of trees, living almost entirely upon fruits or nuts that the trees produce, and, in short, making the forest their home, as the fishes live in the sea or many birds in the air.

Compared with these tree-dwelling monkeys. the

more man-like apes oftener descend to the ground and make their way through the thick undergrowth or the jungle. And so scholars believe that mankind is truly a race of animals, once especially fitted for dwelling amid the trees, even, perhaps, chiefly among their branches, and yet a race that, thousands of years ago, abandoned this habit of its animal ancestors and gradually fitted itself to live everywhere upon the earth.

But the same reasons that in the far distant past made the forests and the trees safe for monkeys and apes, continued to make the same dark shades and handy climbing places the resort of mankind before they were able to face the dangers of the open plains and to brave the dangerous animals then found everywhere.

We have shown before that man, owing to his unprotected body, has always felt the need of shelter. It is true that some races found this in the caverns that existed naturally, or that could be scooped out of the earth, but other races found that the simplest shelter was beneath great trees, or could be made by tying branches together to make a roof.

THE FIRST SHELTERS.

The simplest forms of dwellings, such as many African tribes used when they were first discovered, are most easily made by tying together at the top a group of poles, of branches, or of reeds. Some of the American Indians on our western coast still are satisfied with their "hogans,"—rude shelters of boughs made in this way. But the men who dwelt in the great forests of Europe, as soon as they had made tools that would cut wood, began to improve their homes. Even a rude stone axe will in time cut down a small tree, and very comfortable houses of large size and offering much comfort were made with no better tools than this by the South Sea Islanders.

When metal tools had been constructed, and the cutting of wood thus made easy, men no longer needed to take their chances of finding shelters almost ready made. They could cut timber, fit it together, and thus make for themselves not only houses, but fortresses. Instead of escaping from wild beasts by climbing trees, they could build up walls of logs, forming strong houses, and could surround these by fenceworks, or palisades—which is the name given to walls built by putting trunks of trees upright and close together. The structures thus made were oftentimes well built, serviceable, and often luxurious.

THE FOREST SETTLEMENTS.

When we have come to this period we are in times of which history tells us. We know that at the time when Julius Cæsar conquered Gaul, most of the homes, fortresses, the shelters, the towns and strongholds, were constructed from the trunks and limbs of forest trees. They were built with skill, and could for a time resist even the clever Roman armies. Not only did the Gauls make big halls, large enough for banqueting, but they erected great towers, rising far into the air, only to be captured after dangerous sieges, and easy to be defended by warriors armed with bows and spears.

In Britain also were large towns, the houses of which were made of logs and the walls of which were strong palisades. Of these the early history of Britain gives us full accounts, and the word “town” is the very word used by the old Britains to indicate a settlement of this sort. In our own country the most advanced Indian tribes, the Iroquois and the Algonquin, such as were met by the early explorers of Virginia and the settlers of New England, lived in strong settlements—villages of huts, constructed of tree-trunks, and securely palisaded.

It was only when the working of stone had become

easily possible, through the improvement in tools and the learning by men of methods of working together, that the finer buildings were constructed of masonry. Most old cities passed many centuries as collections of wooden buildings, among which there stood a few great public structures, such as churches, town halls, or storehouses and fortresses, that were best built of stone or brick.

So we see that mankind, for much the longer period of life on this earth, has depended for shelter and protection upon the vegetable world.

LOVE OF PLANTS AMONG PRIMITIVE PEOPLES.

As men had for untold ages thus found their homes, their family life, their protection, and, in short, all the pleasanter side of living to be connected with the forests and with the growths about them, there came to be a feeling, at first of liking and pleasure in, and afterwards of admiration for, the plants that meant so much to the species. No doubt at first the savage looked upon the great tree as merely a thing to climb when he heard in the jungle the cry of some dangerous creature; but in time the tree, his shelter, came to mean something more than a mere place of retreat, and in the same way the plants that gave him food, and thus attracted his notice, came at length to awaken his admiration and his affection.

We have already seen, in going over the history of man in very early times, that he soon became an artist, able to notice and to sketch upon bone, or upon stones and clay, the forms of animals. This proved that he had an eye able to see and to enjoy beauty of line. We can also be sure that he had some liking for color, since the races of savages that now represent the same sort of life, enjoy at least the brightest colors and use them to decorate themselves and their possessions.

While it is true yet that the natives living in the South Sea Islands are a superior sort of races, yet we

may believe, from their admiration and enjoyment of flowers that the pleasure of these beautiful shapes and colors came early in the history of our race. The South Sea Islanders, when first discovered, wore garlands and wreaths of flowers on all festal occasions, and honored their guests by decorating them in the same way. Indeed, it seems absurd even to doubt that in the tropical lands, where birds are so brightly colored, where the jungles bring forth wonderfully beautiful blossoms, where there is no season of the year when these are absent, that mankind could have come to have any intelligence without caring for these beauties of nature.

FLOWERS IN OLD STORIES.

If any other proof were needed than mere likelihood, it is to be found in the earliest stories that have come down to us from times more ancient than we can know. In these we find that flowers played a very prominent part. There are many stories in the old mythologies, not only of Greece and of Rome, but of the nations from whom the religions, the poetry, and the stories of these two peoples were taken. The native Egyptians, for example, held the lotus flower sacred. It was a symbol in some way connected with the gods and with wisdom, being used especially in their drawings or carvings as a support for a god or a sage. The same flower, or one of a similar species, is seen in the art of Japan and China, and is believed to have come to them as a symbol from India. In the Homeric poems we also hear of the lotus, though it is doubtful whether this is the same flower as that represented in Egyptian art. Here at least, then, is one flower that is found to be regarded by a number of ancient nations as having some special meaning and importance in their art or religion, and seeming in each case to have been so regarded by races even more ancient than themselves.

EARLY FLOWER-GARDENS.

When it was found that man could for himself raise the fruit-plants and the grains, that is, when he ceased depending merely upon what grew wild, and learned to raise for himself the food that he needed, we may be sure that those plants which were liked for their flowers, or for their foliage, were also planted, by the women at least, so that they might have the pleasure of seeing around them the beautiful flowers, the trailing vines, or the colored foliage that they met in the woods or fields. Indeed, it is quite possible that the love of flowers and the attempt to raise them, either from the seed or by planting branches or slips or bulbs, may have come even before it was generally the custom to raise food-plants,—that is, while food was gained by hunting and fishing.

This may well be true, because it is still found among many savage races that the love of ornament comes even before the desire for clothing or prudence in providing food; and some wise men think that dress was worn for ornament earlier than for warmth or comfort. If this be true, we may well believe that the beginning of agriculture might come from the desire of women or children to keep alive the flowering plants that they had picked in the woods, by planting them near their homes.

BIRDS AND INSECTS LOVE FLOWERS.

Even among some birds and animals naturalists have found habits that are hard to explain except by a mere love of beauty. The bower-bird, for example, arranges for itself a sort of garden, or dancing place, and brings to these “bowers” flowers and other bright-colored objects. And this is not the only example of an apparent love of beauty among lower animals. In the earlier chapters of this book we have spoken of the beauty of the sky and its clouds, saying that there seems no reason for that beauty except the enjoyment

it gives. And here, in the same way, it may be said that there is no reason which we can imagine why all forms of plant-life should have so many elements of beauty in form, in color, in surface, except that these should give pleasure to other living creatures.

Certainly, whatever the beginning of the delight in plant-life, from the superb forest tree towering aloft in strength, to the tiniest flower that brightens a tuft of moss, it has grown in all races of mankind until it is one of the greatest human desires that these beauties should be about us, and that all occasions which we wish to mark with special honor or glory, even with solemnity or sacredness, call for these most exquisite living jewels of nature.

INFLUENCE OF FLOWERS.

Bacon declares that without gardens, buildings and palaces are but "gross handiwork," and says that "building in stately fashion is easier than fine gardening," as if gardening were the greater profession. He next gives a list of flowers and trees and of pleasant herbs and shrubs suitable for each season of the year, in order that every season may have its appropriate plants.

In Shakespeare's play, "A Winter's Tale," there is also a similar list given of flowers, and the two lists closely resemble one another. Shakespeare represents *Perdita*, his heroine, as bringing posies to her guests, and giving to each with a pretty sentiment the right flowers. Both of these great writers speak with the ease and familiarity that show them truly intimate with the nature of the flowers, with their seasons, with their qualities.

When we consider the history of these men, their busy lives, and the nature of the work they did, we shall see that their knowledge of flowers was not the result of study, but came from actual living with them, from seeing blossoms at their very doorways, or upon

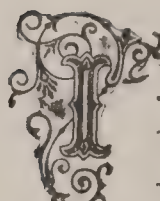
either hand as they went about in garden-like London.

Bacon's essay upon "Gardens" reads more like the journal of a gardener than like the writing of a philosopher. He seems to have indulged his fancy at will, as if he were a child playing at a game of make-believe, for at the very end of his account he admits that he has, in describing a planted plot of ground, laid out a garden "such as a prince might make, without any thought of cost." The essay will always be read with delight by all lovers of flowers and of beautiful plants.

CHAPTER XVII.

Flowers, Their History, Cultivation and Uses.

THE PAST AND THE PRESENT.

N dealing with the love for flowers, we must think of it as beginning, perhaps, with savage woman as she passed through a rough foot-path in the wild land of long ago, and, toiling under a heavy burden, bent to pluck from the tangle at her side some bright blossom that caught her eye, and carried it until it could be thrust into the ground near the doorway of a rude hut. Then it must be followed down through the ages during which a few straggling flowers thus plucked and rooted by the side of a rude home marked the beginning of the door-yard garden. Next we shall see these growing into a part of the home so important that, at least to the women and children, it is the most prominent thing that gives beauty to the home-picture in their minds. We shall see this little garden better tended and becoming a necessary part of even more stately homes; as forming a decoration for the grounds of the temple, of the village hall, and especially as surrounding the church, and beautifying the resting-place of the dead in the shadow of the place where they once worshiped.

Coming to statelier times, we shall see the garden made into a formal place regulated by strange rules ordering that a path shall go this way or that, that flower-beds shall be shaped by the rules of arithmetic rather than by those of beauty; that trees and shrubs shall not be left to grow as nature meant them, but shall be clipped or bent until they (like the paths) become square and sharp of angle; or they are made to represent birds, boats, even awkward likenesses of

men and women, to suit the strange tastes of the formal times.

Though the freedom of nature came back, something of what was good in the formal gardens was retained—the well-ordered lawns, the pretty fountains, the carefully contrasted coloring, the well cared-for flower-beds and parterres, the borders or hedges of neat boxwood, or hawthorn, or osage orange, or of other hardy plants.

FLOWER RAISING AS A SCIENCE.

In the beginning, the garden plot was the care of the housewife. Then, as we have seen, when great households grew up, and the varying work was given into the charge of special workers, it came about that gardeners were trained. Just as each great house had its hewers of wood and drawers of water, its stable men, so it had also, not only its farm laborers, but those to whom the raising, the care, and the furnishing of flowers and ornamental plants as living decorations without, or as ornamental helps to festal occasions within, was a profession.

And this state of things was succeeded by another, one that brings us down nearer to our own times. Although the great houses remained, in many countries, with their gardens for the benefit of the rich owners; and although the little gardens surrounding poorer homes were also found, as they have been since the very earliest plot was planted; yet, with the building of great cities and the many kinds of trades and professions that grew up to supply all the delights of country life to those who lived where these could be had, there came to exist another business—that of flower growing and flower selling.

Gardens were established for the benefit of those who had none of their own, but whose work gave them money now and again to buy the flowers they could not grow. Men made it their business to supply the

roses for a ball-room, the early violets for the society women, the flowers that were carried by those who wished to sport the colors of a university at some athletic contest, the bridal wreath, or that which was an emblem of love and grief upon the death of a beloved friend.

With such commercial gardens there came the desire to compete for the trade which brought the money return. The seller of flowers demanded by fashion would reap the most profit if he could bring his early blossoms to market while yet they were rare. As the farmer had learned the science of raising food-plants, so the gardener had learned all the farmer's methods by which plants could be made to grow out of season, to blossom before nature's time, to produce abundantly, even to afford varieties such as nature, unhelped, could not offer.

Together with the science of fertilizing the ground, of nipping off an unnecessary bud, of pruning a branch, and of grafting upon one plant a branch from another, was added a knowledge of how to breed from two plants at will so as to keep something of the character of both parent plants.

Great hothouses have been built covering acres, with glass enclosures. The hothouse itself is a wonderful contrivance, based upon the discovery that the sunshine will pass through the glass panes, carrying its heat, but that once within, the reflected rays of light are unable to escape from the trap without leaving much of their heat behind them. Consequently, under these wide glass roofs, and behind the glass walls, the gardener finds it easy to make a tropical climate. If the sunshine is not enough, by means of lamps or fires or hot-water pipes, he can make a safe and warm asylum wherein the flowering plants will live and thrive, even in cold climates, as readily as if they were in the warm regions beneath the equator.

He can give, to those willing to pay the price, any

desired flower, no matter what the season of the year; he can collect from all the four quarters of the globe the rarest and most beautiful plants, and can raise them, generation after generation, so that the dweller in the North may see and enjoy plants that formerly thrived only in the depths of the Brazilian forests or in the great moist plains of southern India, or upon some remote island in the mid-Pacific or the Indian Ocean.

FLOWER SPECIALISTS.

The earliest gardens had no reason except the delight that the flowers gave their owners as objects of beauty. But when the gardens and hothouses were thus changed into business enterprises, it came about that many found chief profit in raising a few varieties only. They became specialists. When, for example, it was necessary to know deeply and scientifically the facts concerning any plant which it was desirable to raise in large quantities, it was easier to do this if not too many were studied. One commercial gardener, therefore, would probably give his time entirely to the growing of a few varieties of roses, another to violets, to tulips, or to chrysanthemums. Then, when success in raising one particular variety had given him a special interest in it, it would become a prize and a rarity in the market. Flowers thus came to have special names, and to grow into well-known and prized varieties.

It is a law of vegetable life that now and then will occur what are known as "sports." For example, a flower will come of a new hue, or with a different number of petals from its ordinary shape. If these sports are such as to please, the skillful gardener will try to keep the variety alive. Success will mean the creation of a flower for which buyers may eagerly compete. For such have been paid enormous prices. An example of this that is very recent is a peculiar

variety of pink, for which it is said that thirty thousand dollars was paid.

Besides these strange varieties, many of them chiefly of interest to the curious, the care given to the cultivation of fine flowers tends to bring about a change that is more or less regular, a change which makes most cultivated flowers, or garden flowers, differ from those which are still growing wild. To illustrate this, let us compare the wild rose with the many cultivated varieties that are commonest in our gardens or are most prized by flower lovers.

FLOWERS WILD AND CULTIVATED.

The wild rose, such as we see growing along old fences, in old meadows, and by brambly paths, is a simple five-petaled flower, with an open cup wherein is a ring of golden stamens. The blossom is exquisite in shape and in color, but it has little need to last long. Its blossoms show its beauties only long enough for the wandering bee or other insect to alight upon it and leave the pollen required for the life of its seeds. This work once done, the petals fall, and the plant gives its care only to the seeds within the round calyx that later in the season ripens and turns a bright red.

Now let us see what the work of the gardener has brought about in the case of the cultivated rose. Instead of the five petals—how many are there? It will be, in many species, a difficult task to count the rows upon rows of tightly crowded petals that seem hardly to find room within the bud or upon the calyx top. Instead of spreading widely outward, so as to make a bright and attractive platform for the alighting of some insect, the cultivated rose uncloses as grudgingly as the hand of a miser, and must crowd still more closely the thronging petals that the stamens may be shown at all or the little pistil may see the light of day.

More remarkable still, the *habit* of the flower has been changed. No longer is it careless of its petals. They must, of course, be dropped; but the skilled work of the gardener has made them cling to the calyx so long that the beautiful rose may be kept for days by those who enjoy its beauty or would preserve its fragrance.

A similar change, sometimes greater even, has been wrought in most of our cultivated plants. The simple plant has become greatly complicated, the color greatly strengthened, the petals more numerous, or the one hue has been variegated so that different varieties present (as in the case of pansies) a bewildering multitude of patterns. The gardeners have become veritable wonder-workers, and are able to produce flowers almost as one may order them.

Go, for example, to one of the chrysanthemum shows, where fanciers of these remarkable blossoms show them from the tiniest button of color to enormous shaggy creatures who remind us ludicrously of the heads of blond football players. We find all possible shades of color, from pure white to the darkest hues of gold and crimson. Not all of these productions are beautiful, of course. They show that they are the result of an unnatural bringing up. But many of them must, from any point of view, be considered quite as beautiful as the small, simpler wild varieties from which they have been improved.

Each of the best known flowers has, nowadays, its well recorded history, extending, in many cases, over several centuries. They have been traced from garden to garden, from field to field, in the Old World and in the New. Some of them, after receiving years of care and being changed greatly from their first wild forms, have been once more turned over to the care of Dame Nature, and are now civilized creatures run wild. This is well known concerning some varieties in our own land. They were brought by the first

settlers, reared with care in early gardens, and then, as these gardens were deserted, have been free to scatter their seeds abroad, to "escape from cultivation," as it is called, and to start a new life in the American fields and woods much as the settlers who brought them over have also left the more civilized parts of our own country and sought in the wilderness to find new homes.

THE ORDER OF COLORS IN FLOWERS.

In studying the history of flowers since first they appeared on the earth (for the very earliest of plants had nothing that could rightly be called a flower), it has been suspected that the first change in the color of the leaf that was to become a flower was to an absence of color, so that the oldest forms of flowers were white. Next in flower history came the color yellow, and then, in order, red, blue, purple and violet. This only means that in their change toward greater perfection flowers have taken on color in the order given, and that the violet hue is the last to be acquired.

The reason why this is asserted is because the simplest flowers—those that are the least developed—are most likely to be white or yellow; while the flowers that show the greatest change from the simpler forms—that are complicated, or are specially shaped to some need—are most likely to be blue, purple, or violet.

But this is not by any means a certainty, and should not be taken as proved. At least, it will be interesting for young observers to notice for themselves whether the rule is well established.

It is also said that not all *three* primary colors can be found in any one species of flowers. Thus, if they are red and yellow, they are *not* blue.

THE PLEASURE GIVEN BY FLOWERS.

Even after the beautiful flowers have played their part in weddings, receptions, balls, and other festivi-

ties in the homes of the well-to-do, they are capable of giving an unmeasured amount of pleasure. There is in the United States a "National Plant, Flower, and Fruit Guild," which makes it a business to collect flowers that have served their purpose as adornments for these functions and still are fresh enough to give pleasure to poorer people or to the sick in hospitals. Thus a newspaper tells us that from one wedding alone eight thousand blossoms were received to distribute among the poor. Besides these, there were more than a hundred potted plants that, after they had served to decorate the church, were passed on, that each might go to a crowded tenement, bringing beauty and joy into the sordid life of some poor dweller therein.

An officer of this society says that many of the wealthy not only give flowers, but load up their motor-cars with the gifts to save the society the cost of carrying them about. She adds: "You should see the pleasure the flowers give. Some of the children really think they come from heaven." A little crippled girl, on receiving a bunch of roses that had done duty at the "tea" of a *débutante*, said: "God's lady from the moon gave me these." Another bunch of roses went to a poor man whose wife had just died, and he put them in her poor dead hand. Nor would he let fresher flowers replace them, saying, "They are the first given to her since she was married, and she is going to keep them."

This Guild has done marvelous work, not only in distributing flowers in this way, but in teaching children to raise them in city parks.

A very great trade with France is concerned with the yellow immortelles. They are greatly used by florists in making funeral emblems and for other memorial work. In spite of the fact that there is a tax upon the importing of these flowers, the United States received, recently, forty thousand dollars' worth in

a single year, and thousands of acres abroad are devoted to raising them, along the Mediterranean Sea. Each acre is said to produce 20,000,000 of the blossoms. After they are gathered, they are bleached white, or colored any desired shades, shades usually exceedingly bright. This work is done by women and girls.

FLOWERS AND THE POETS.

As the poet mind is one that is especially quick to appreciate beauty, there is no great poet in whose works references to beautiful flowers are not to be found, almost upon every page. Especially notable for their love and appreciation of flowers are those poets who flourished in the Elizabethan Age, a period in England when the love of home and country was very strong.

Shakespeare seems to revel in painting the beauties of flowers for us, in words that no other has ever chosen so well. Not only does he speak of their beauty, but always they are treated as living things, proving that the poet had not only seen, but had lived among and loved them.

Milton also has the art to describe flowers in words that leave little to be said. An especially beautiful passage in his poem "Lycidas" could not have been written by any except an ardent lover of flowers:

"Throw hither all your quaint enameled eyes
That on the green turf suck the honeyed showers,
And purple all the ground with vernal flowers.
Bring the rathe primrose that forsaken, dies,
The tufted crowtoe, and pale jessamine,
The white pink, and the pansy freaked with jet,
The glowing violet,
The musk-rose, and the well-attired woodbine,
With cowslips wan, that hang the pensive head,
And every flower that sad embroidery wears."

It is not at all unlikely that in writing this passage in a lamentation over the death of a young scholar,

his friend, Milton should have had in mind the meaning attached to the flowers which he names. The lists given differ somewhat, but agree generally in the sentiment attached to the better known flowers, and, interpreted by such a list, we find that the flowers Milton names in the order given, bear the following meanings: Early youth and sadness, ingratitude, loveliness, talent, faithfulness, love, fraternal love, sad thoughts. It certainly seems as if the poet had chosen these flowers to indicate his own feeling over the death of his friend. And how beautifully he has pictured them, even in the mere word or two given to each.

Elsewhere we have spoken of the sunflower seed as being a food, but this plant also should be mentioned as a curiosity among flowers because of its great size, since, in its home, tropical America, it grows as tall as twenty feet, while the flowers are from one to two feet across. In Russia it is grown as a food crop. From the seed comes a valuable oil. It is made into a food for infants. The Russians eat the seeds at dessert as we eat nuts. The American Indian can make bread from the ground flour. To the bees the flowers are a rich storehouse of honey, cattle feed upon the leaves, and even the stalk has a value, since it makes an excellent fuel.

An English paper says that we can have no idea of how rapidly this flower can spread until we have seen an abandoned garden in which the plants have been left free to scatter their seed. The account declares: "In every bed and borders in the gravel paths, in the lawn, in every imaginable corner, sunflowers, self-seeded, spring."

Another writer compares the roasted seeds to roasted peanuts, and claims that their oil approaches nearer in value to that of the olive than that of any other produced from plants. He adds that the fiber of the stalk is so silky and strong that the Chinese

weave from it valuable fabrics, and suggests that here is a possible new material for American industry.

Thus we see that there are most valuable qualities in some of our least regarded plants, and one is tempted to think that sufficient study of nature will reveal treasures on every hand.

Certainly we should be most grateful to flowers, and most careful of them. A wealthy flower-grower who sent a large contribution of flowers to be distributed among the poor, sent with them a tag upon which was printed the following, adding to his gift a pretty sentiment:

FLOWERS O' DREAMWOLD.

We are alive, just like little boys and girls. When you're kind to us we hold up our heads and smile. If you're cruel, neglectful—of course, you won't be—our heads droop and we die. We feed on water and God's beautiful sunlight, and we're always hungry, and in our home where we were raised we have always had plenty of both. In the daytime we have always been chummy with the birds who sang to us, and the bees whom we fed, and the butterflies who shaded us with their pretty wings when the sun was too hot; at night the frogs' lullabies have always put us to sleep, and the crickets' songs have brought us pretty dreams, and every morning the robins told us when to lift up our heads and open our eyes. We tell you these things so that you will be good to us and be sure and remember that we are always hungry for our sunlight and water.

FLOWERS AS CLOCKS AND AS BAROMETERS.

It has long been a favorite device with gardeners to plant flowers so that each hour of the day a different variety will be open. There have been a number of lists given for various countries, the earliest being mentioned by an old Roman naturalist. We shall not attempt to give the list, but will note a few flowers that will serve roughly to tell the time.

The jonquils open at half-past five, and close their petals at half-past eight in the evening. The hawk-weed is open from eight in the morning until about two in the afternoon. The yellow goatsbeard is declared shut just at noon; the sow-thistle, opening at

five A. M., is closed by noontime; the white lily is displayed from seven in the morning until five in the afternoon. From books on gardening it will be easy to get lists that will form a true floral clock, quite as good a time-keeper as the watches of most of our young readers.

As a barometer, or instrument for foretelling rain, certain flowers may be depended upon. One of these that gives early warning of the coming of heavy clouds or rain is the little scarlet pimpernel, that grows wild nearly everywhere. It is chiefly useful to consult in the morning, as it always shuts up by two o'clock, and does not open at all, even for the morning, if the day is to be cloudy or rainy. It is for this reason that it has gained the name of the "poor man's weatherglass."

Thoreau, our charming American writer, and the American poet, Celia Thaxter, both refer affectionately to this little scarlet flower, and Miss Thaxter speaks thus: "When the sky was yet without a cloud, softly it clasped its small red petals together, folding its golden heart in safety from the shower that was sure to come. How could it know so much?"

Other plants likewise foretell rain. The tre-foil contracts its leaves, chickweed closes its flowers, and the clover feels rough to the touch. The common sensitive plant that folds its leaves when touched is also apt to close them together face to face when rain is expected.

CHAPTER XVIII.

The Story of Some Well Known Flowers.

HOW THE FLOWER WAS FORMED.



WE have spoken of the fact that the great poet Goethe was among the earliest to suggest that all parts of plants were modified from a few simple beginnings. A study of how flowers came to exist shows that the process came from a shortening of part of the stem and the bringing together of certain leaves. So a flower is no more than a bunch of leaves that have in course of time been changed in their form and their color as well as in the work they do for the benefit of the plant.

It is the flower which has to do with the preparation of the seed for the new plant. This is so formed as to receive the powder known as pollen from another flower of the same species, and to convey this to the seed, which, by means of the stimulation that comes from the touch of the pollen, is caused to begin its growth. For this purpose of receiving pollen and leading it to the seeds, the central parts of the flowers usually have been made ready. The outer part of the flower serves to attract the insects who carry the pollen, sometimes to protect the seed parts from water or wind, or to enclose it, if necessary, when the weather is cold. These outer parts are the ones that usually are brightly colored, or at least different in color from the ordinary leaves.

FLOWERS FOLLOW A PLAN.

Since these flower parts are formed from a change in the leaves themselves, and since the leaves in all parts follow a plan or regular order in their arrange-

ment, it comes about that the arrangement of the leaves on the plant may often be traced in the arrangement of the parts of the flower.

Thus, if the leaves occur opposite one another in the plant, the flower parts also will be found arranged in opposite pairs. Where the leaves are alternate, that is, when one comes opposite a space and another follows opposite another space, then the flower parts, too, will show a trace of this arrangement.

The buds which come before the leaves are found either at the end of a stalk or branch, or else are what is known as axillary. Axilla, in Latin, means arm-pit, and so the word axillary means in the opening or hollow between the stalk and the larger stem. From what has been said of the flowers coming from leaves, we will see that the same general rule applies to them as to their position. They, too, at least in the simpler plants, are either at the end of stalks or grow in the space between the stalk and the stem.

In many plants the change from flower to leaf is not yet so complete, although we can trace the method of change. Sometimes we will find in flowers that some of the parts have "gone back," or at least never completed the change, and so still present the leaf-form which in earlier ages was regular.

Only a very careful, close study of botany will enable us to understand how wonderful are all these changes, but it will be enough to remember what we have said here—namely, that in the flower we have a special form of changed leaf or group of leaves.

Here, too, therefore, we see something of the great story of development concerning which we have told you in speaking of the origin of our race. As an example of the great change from leaf to flower in a simple form, the water lily is often given; and for an example of how completely the change may have departed from the original form, we need speak only of the great class known as composite flowers, of which

the thistle, the daisy, and the asters are examples. Here one would never guess that the hundreds of tiny flowers have been formed from the leaves of the ancient form of the plant.

SOME PUZZLING FLOWERS.

In the course of their change in past times, some flowers have ceased to produce parts that exist in most. The main parts of a flower may be said to be the calyx, or seed-holding cup, the corolla, or broad spreading petals, the stamen, and the pistils, the stamens being the parts that bear the pollen powder, the pistils being those which receive the pollen and convey it to the seed.

Now, all these parts may be so gradually changed, so increased or diminished in number, as to become exceedingly puzzling. Of course there is always some means of bearing the pollen and of receiving it, but there does not exist always that clear arrangement of parts which makes it easy to tell at once which part does a particular kind of work.

There may also be in the various parts of the flower a very great increase or decrease of size, as if one part took all the nourishment, or nearly all of it, and grew to a great size, while the others were reduced merely to a trace of what they should be, were all parts regular. In some flowers, for example, there are a number of petals nearly all the same size and shape. In another species we may find a few petals large, and the rest very tiny. Sometimes only one petal will be well developed. The same thing is true of the stamens and pistils, which vary endlessly in different species.

When, as we know, a whole book is devoted to treating the varieties of even one kind of flower, such as the rose or the lily, it is plainly impossible for us here to do more than to speak of a few of the commonest garden flowers, in order to become acquainted with

how they have been selected from many of the wild flowers, and then have been trained and cared for until they present the marvelous varieties that are the triumph of gardening.

Remember that the history of these best-known plants goes back so far that the first selecting and growing of them is not even recorded in our earliest histories. Nor by the help of the wisest botanists can we trace their wanderings and learn in what country they probably first attracted the care and admiration of mankind.

THE ROSES.

Probably no other flower has so greatly spread and so widely changed under cultivation as this queen of flowers. Even of the well defined species there are perhaps a hundred, and there are well recognized varieties of these, several thousand in number. And the list is continually growing as new ones are produced.

The plants may stand erect, may trail or climb. The flowers are white, pink, red, yellow, and crimson. The oldest writings of mankind speak of it, and as far back as we can trace the flower we find that the simple wild rose has already become what is known as "double," that is, has increased the number of its petals.

Yet roses are chiefly raised simply for their beauty, though the perfume is exquisite, and is manufactured in large quantities. A few roses bear a fruit that is eaten, but the vast majority of the flowers are raised because the bushes and flowers are so extremely ornamental. No other flower is so generally grown and so generally valued. Within the last sixty or seventy years the industry of growing roses has risen from nothing until in the United States alone the annual crop is valued at about \$6,000,000.

It is hard to tell where the wild rose originated, as it is found throughout the world within a wide range of climates.

One thing that shows the many ages through which this has been a favorite flower is the fact that in nearly all languages we find very much the same name given to it. The oldest of these names seems to have come from the East, where it meant simply "the flower," so it may be that Queen Rose was very nearly the first favorite of flower lovers.

As we have already said, in speaking of the change of wild flowers when cultivated, the first form of the rose had only a single row of petals, but when the flower is cared for, some of the stamens are changed to petals, and the flower "doubles" until it is like a nest or cushion of exquisitely curved petals. So much has it been changed by gardeners that we can hardly tell how many of the species came to be.

The chief kinds are the climbing roses that spread as vines, and the garden roses, blooming once in summer and growing on a bush, which were for many years the favorites. Next there is a species that blooms late in the year, and blooms twice. These large, brilliant flowers, such as the Jacqueminot, are favorites among florists. Another species blooms again and again upon the hardy plant, and these are well suited for cultivation in the houses. The English often cultivate choicer species by budding them upon the ordinary stock, but Americans usually grow each kind from its own plant. Altogether, this flower well deserves its title as Queen of the Garden.

THE LILY.

Because of its grace and beauty this flower is commonly ranked second to the rose in popular favor. There are some fifty species, all being natives of the Northern Hemisphere. About one-third of these grow in the Oriental countries; six come from India, eight from Europe, and fourteen are found in our own country.

This flower was already in cultivation four hun-

dred years ago, when it was described by an old botanist, who then told of eight different kinds known in Europe.

In its form the flower takes three main styles: trumpet-shaped, with a long tube; a shorter form, with petals widespread; or the flower hangs downward with the ends of its petals turning outward and upward. All grow from bulbs, and a number of these bulbs are eaten, in Asia.

The beautiful white lily was known in the oldest days, being mentioned by Homer, together with the rose and the violet, as favorite flowers. Both the Old and the New Testament contain many references to lilies, one of the best known being those lilies of the field, the beauty of which was declared to be far beyond the glories of King Solomon arrayed in regal grandeur.

We have already spoken of the lilies of France, but it is probable that the figure of the fleur-de-lis, though called a lily, originally represented three lance-heads, and not any flower.

From pure white or scarlet all the coloring of lilies is exquisite, a number of them being decorated with purple or brown spots, which have a striking effect. Sometimes they are grown upon a single stem, at others as many as twenty flowers will be grouped together. So suggestive of purity is the pure white petal, that the word lily itself has often been used to mean beautiful and pure, as where Tennyson, in his "Idylls of the King," speaks of "the lily maid of Astolat." The name lily, however, is applied to several flowers that do not truly belong to the true lily family.

THE VIOLET.

The violet also is principally a flower of the cooler regions, though there are some in South America and Australia. They are low-growing plants, each flower

on its own stalk, or, more rarely, two are at the end of one stem. The parts of the flowers are in fives, with the lowest petal larger than the rest, as this petal is the platform upon which insects alight. There are from one hundred to two hundred species, the number being uncertain. Some of the varieties, like the pansy, are extremely rich in color, differing greatly from one another, for the pansies are classed with the violets.

The garden pansy, or heartsease, as it is also called, is thought to have been cultivated from a weed found in the corn-fields, and first raised early in the last century by an English noblewoman and her gardener, a Mr. Richardson. The color of this flower, together with red and green, compose the three actual primary colors of light, and its name, therefore, denotes this pure tint as found in the spectrum.

Like the rose and the lily, the violet has given us a favorite feminine name. These seem to be the only common names that are taken directly from flowers, though the goddess Flora, Hortensia, meaning a woman gardener, and the name Olive, all show some connection with a love of plants. To this may perhaps be added Phyllis, meaning a green bough, and Sylvia, meaning a wood maiden, or nymph.

The fact that the three flowers already spoken of are the only ones which have been so loved as to give names to children is a proof how long they have reigned as favorites. In the case of the name, Daisy, it probably first was a nickname given to a Margaret, but Margaret really means a pearl, and was only later applied to the flower. It can hardly be said, therefore, that in its first use, love of the flower gave rise to the name.

THE PINK.

Like the violet, the pink is a flower which has given its name to a color. The name includes not only the true pinks, but a number of other flowers that resemble them and yet belong to different species. Originally

the name was given to the flower because of its rough-pointed edges, as the word means jagged, pierced, or pointed, being connected with the verb "to pink" or "to pierce."

The flower's origin was around the Mediterranean, though a few are found farther north in Asia and further south in Africa. Two species grow wild in England, and two others were natives of central Europe, and from these the pinks and carnations of English gardens have been grown. As the clove pink was the first form of the cultivated flowers, and is found on old Norman ruins in England, it is supposed that the flower was brought over by the Normans after the Conquest. The original wild flower was of one simple shade, a lighter or darker pink, but the gardeners have produced an endless number of varieties which are streaked or banded with color in striking patterns. The striped and banded pinks were what old writers called gillyflowers. A favorite descendant of the pink is the sweetwilliam, one of our prettiest small flowers.

THE TULIP.

As has been said before, each of our garden flowers has its history, and to learn these in detail one would have to go to many special books upon the subject. In general we have traced a few favorite varieties to show how the simple, more plainly colored wild plants, when taken into gardens, carefully tended, and rightly bred, reward the gardener by richness of color and variety of pattern. Somewhere between the earliest simple form and the most highly cultivated varieties will, in most cases, be found the most beautiful form of any common flower, for there is an overgrowth and an exaggeration possible that loses the more beautiful lines and the more delicate hues which the true lover will prefer.

Among those which have most engaged the care of

cultivators, the tulip must be mentioned. This was an eastern flower, cup-shaped, brightly colored, and has been a favorite for two or three centuries. They have been bred in such bewildering variety that it is hard now to tell from what earliest forms the strangely varied, fancy varieties are descended. Even recently, new wild flowers have been discovered and introduced into Europe.

Even without the gardener's special effort, the tulip, when cultivated, changes into a number of different varieties.

The bulb of the tulip is remarkable in that at the same time it contains two other bulbs, therefore providing for a three years' succession of plants.

Nearly four hundred years ago began a special interest in this beautiful flower, when a few seeds were brought by an ambassador to Turkey from a garden near Constantinople and carried to Vienna. In thirty or forty years the plant had become a favorite throughout Europe, especially in Holland, and from about 1634 the flowers had grown in fancy values to such an extent that enormous prices were paid for bulbs, \$5,200 being the price given for one of the most valued. People formed companies with the idea of raising tulips on shares, and this started a speculation or gambling in tulips that has since been known as tulipomania. When many families had been ruined, the Dutch Government was obliged to interfere.

During this craze for the flower a number of amusing instances occurred, the bulbs being mistaken for onions or other vegetables. Thus a sailor, while waiting in a merchant's office, coolly devoured several bulbs worth thousands of florins. And another merchant, to whom some choice varieties had been sent, likewise made a meal of them, only to discover how wasteful he had been when a following letter told him the values placed upon the by no means delicious vegetable.

Although the craze has long ceased, the real love of the flower for its beauty has still caused it to be especially cultivated and very highly valued. Among others who raise beautiful varieties are some recent experimenters in the State of Washington.

There is a special name for the differently colored varieties, "selves" for flowers of one color, "roses," where tints of red are present, "bizarres," where certain fancy varieties have colored borders, and "bybloemens," which include the dark flowers—purple, brown and black. Nor are these by any means all the classes into which the varied flowers are divided. We have spoken already of their changing by themselves, even when most carefully cultivated. It takes several years to raise the flower from seed, and so most tulips are produced from the smaller bulbs which the larger include.

The Dutch have a society made up of those who grow bulbs from flowers, which numbers nearly three thousand members and supports a paper, holds meetings, and by means of committees examines reports upon new varieties. In Holland vast areas of country have been changed to fit them to the growing of bulbs, and the plots best suited sometimes amount in value to as much as \$2,400 an acre. England buys most of the bulbs, and there are some three or four thousand persons engaged in this industry.

About April commences the wide blaze of color showing the flowering of the tulip beds, so that for two or three months great fields are brilliant with color.

We have spoken of one tulip bringing an enormous price. It is claimed that the highest price ever given for a flower was paid for a single choice tulip—one account fixing the price at \$250,000! But this is likely to be a wild exaggeration, for another item said the amount paid was 50,000 francs or ten thousand dollars, and another said \$5,200.

THE MEANINGS OF FLOWERS.

Different flowers have come to suggest special meanings, and in many countries the meaning is so well recognized and agreed upon as to permit of a so-called Language of Flowers. We read of messages conveyed in this way among both the Greeks and Romans; and although later the flower language was for a long time forgotten, it was revived again in the Middle Ages, when it found much use in connection with knighthood and heraldry. In the East also the language of flowers has for years been well understood and much used, especially between lovers.

Although the meaning given to various flowers differs to a great extent among different nations, yet it is natural that there should be some agreement as to what is signified by some of the best known. The rose, for example, is oftenest taken to mean love and beauty; the forget-me-not bears the sentiment that its name expresses, and signifies truthful love; the pure white lily has been recognized by many nations as the choice symbol of purity; the violet, that seems to hide itself among the grass, has always betokened a shrinking modesty; the daisy and white violet bear the meaning, innocence or simplicity.

Other examples of flowers whose meaning is well known, since it depends upon some character of the flower itself, are given in the following list: The rose-mary, remembrance; the amaranth, immortality; the pansy, thought; the poppy, forgetfulness; the primrose, youth.

The meaning of the laurel wreath as a sign of victory has existed for many centuries, and the rose as a symbol of silence goes back to the early Egyptian days.

Nor is the selecting of favorite flowers as the emblems of nations or states at all new. Ancient Athens chose the violet; the lotus has long been the emblem of Egypt; and everyone knows that the

thistle, the shamrock, and the rose, signify the three great divisions of the United Kingdom. To these, for Wales, we must add the leek, which is mentioned in Shakespeare's historical plays.

Families also had their flower badges, as was seen in the War of the Roses, in English history. Spain has the pomegranate, Japan the chrysanthemum. On our own continent, Mexico has been signified by the cactus plant longer than history can trace the connection.

It would require a whole volume to tell even briefly the many cases where a flower has been worn or chosen as the emblem of a party or a belief. In the United States there has been much discussion as to the choice of the flowers that should be emblematic of the States and of the Nation. In a few cases the people's choice of a flower has been enacted into a law by the Legislature. Thus Utah recognizes a certain variety of lily; Vermont, the red clover; Nebraska, the golden rod; Iowa, a wild rose; and so on.

Boys who have declaimed or heard "The Battle of Ivry," Macaulay's poem, will not forget the emblem of France as they recall Henry of Navarre's stirring address to his soldiers, bidding them "Charge for the golden lilies, ye gentlemen of France!"

A French book of reference tells us that the fleur-de-lis, which was so long the emblem of the monarchy of France, is not taken from any flower which may be called the French national flower, and that the French do not recognize any flower as an emblem of their nation.

This same book adds to these national flowers which we have already named, the narcissus for China, the cornflower for Germany, and the lily for Italy.

Although not all of the States have officially chosen emblematic flowers, yet the matter has been submitted to the school children, if not to the Legislatures,

and the following list shows those which have been chosen:

STATE FLOWERS.

The following are "State Flowers," as adopted in most instances by the vote of the public school scholars of the respective States:

Alabama.....	Golden Rod	Michigan.....	Apple Blossom
Alaska	Forget-me-not	Minnesota	Moccasin
Arkansas	Apple Blossom	Mississippi	Magnolia
California.....	California Poppy	Missouri.....	Golden Rod
Colorado	Columbine	Montana.....	Bitter Root
Connecticut....	Mountain Laurel	Nebraska.....	*Golden Rod
Delaware.....	Peach Blossom	New York	Rose
Florida.....	Orange Blossoms	North Dakota.....	Wild Rose
Idaho	Syringa	Ohio	Scarlet Carnation
Illinois	*Violet	Oklahoma	Mistletoe
Indiana	Corn	Oregon	Oregon Grape
Iowa	Rose	Rhode Island	Violet
Kansas	Sunflower	South Dakota..	Anemone Patens
Kentucky.....	Trumpet Flower	Texas	Blue Bonnet
Louisiana	Magnolia	Vermont	Red Clover
Maine.....	Pine Cone and Tassel	Washington	Rhododendron
Maryland.....	Golden Rod	West Virginia....	Rhododendron

In other States the scholars or State Legislatures have not yet taken action.

*Adopted by State Legislature, not by public school scholars.

CHAPTER XIX.

Perfumes from Flowers.

HE preparation of perfumery from flowers is carried on to some extent wherever flowers grow, but the two great localities where the industry assumes large proportions and where the product finds a world-wide sale, are the East and in Europe, in a noted valley on the coast of the Mediterranean, belonging to France and known as the "Valley of the Var." This is the most noted flower-growing district in the whole world. It is so situated upon the coasts of the Mediterranean as to be well supplied with moisture, and at the same time lies within an encircling fence of hills that guard the flowers from too strong winds or too great a change of temperature.

So, with the sunshine of this favored district, plenty of moisture, and the lack of extreme temperatures, the 115,000 acres of the beautiful valley are the ideal home of flower growing. Here are produced flowers by the ton, coming to maturity according to their seasons, and keeping thousands of workers busy almost throughout the year, as the gathering of the blossoms begins toward the end of April and ends only in March. The largest harvest is that of the orange-blossoms, which are raised in enormous quantities, the crop being some eighteen hundred tons.

Next largest is the rose yield, about half as great in weight, which comes to maturity in May. From the middle of January to the middle of April the violets are gathered, nearly one hundred and fifty tons. In the fall a crop of jasmine flowers of the same size is harvested by the tenth of October. Through late summer and until fall, tuberose, some seventy-five

tons, are raised, and in the late fall come flowers of the cassia, while the working year is begun by the blossoming of the jonquils, of which fifteen tons are raised.

HOW THE PERFUMES ARE PREPARED.

There are two chief methods, the first of which will be understood from a description of the extract from the jasmine (or jessamine) flowers. These white and yellow flowers have an exquisite perfume which, it is said, can not be artificially imitated, and this is the only flower odor that seems beyond the art of the chemist. This odor has long been celebrated by Persian and Arabian poets. Nor is it the only benefit which the flower yields to mankind, since an oil from the leaves and another from the roots both find use in medicine.

Each acre of land upon which flowers are carefully cultivated will yield during the season about five hundred pounds of blossoms, worth more than a hundred dollars. In order to secure the essence which carries the aroma the petals of the flowers are quickly spread over glass trays containing a layer of grease about half an inch in depth. The freshly gathered flowers remain in this press for a whole day, and then are removed and a new layer substituted. This goes on so long as the blossoms appear, the trays being piled one upon another so as to form tight boxes from which the odor can not escape. When the grease has become thoroughly filled with the odorous essence, it is carefully scraped from the glass trays and melted over warm water at as low a temperature as possible, and then put through sieves to strain it.

Sometimes in place of the trays, coarse cotton cloths, thoroughly saturated with the purest olive oil, are used, resting in wire-gauze frames and covered in the same way as the glass trays with the freshly gathered flowers. Then the cotton cloths are squeezed in a press, yielding the oil that bears the odor. It

takes about three pounds of the flowers to impart the perfume to a pound of the grease or oil. Then alcohol is used to take the essence from the grease or oil, giving the extract of jasmine.

Many flowers other than the jasmine can be treated by the same or a similar process, in each case yielding an alcohol strongly imbued with the flower fragrance.

Another method consists in soaking the flowers in a grease that has been melted over hot water, after which the grease is treated as before, with alcohol, and the odor extracted.

HOW VARIOUS FLOWER-ODORS ARE COMBINED.

These methods, as will be seen, produce spirits bearing the fragrance of a single flower, and from these, perfumers have learned to make combinations that will be especially agreeable to their customers. In making these mixtures they are somewhat guided by a certain scale of perfumes prepared many years ago by a scientific man, Dr. Septimus Piesse, who went upon the principle that odors might be arranged in an order from the sharpest to the dullest, or from the delicate to the heavy, somewhat as notes of music are arranged from high notes to low. The scale of odors so arranged was known as the "odophone." In order to complete his scale he used not only vegetable perfumes, but animal substances also, such as ambergris, which is found in some whales. It was his idea that there might be discords in perfumes as in music, and he believed that his scale, which suggested harmonious chords as in music, would help the manufacturers of perfumes to avoid unpleasant discords in combining odors.

There are many vegetable odors besides those yielded by flowers, but we shall do no more than mention a few examples. Some woods are scented, like the aloe or the cedar; some barks, like cinnamon,

yield pleasant odors; many leaves such as thyme, and seeds such as those of the caraway contain essences from which useful perfumes may be extracted.

These are obtained mainly by distilling the odoriferous part of the plant with water, or by squeezing the material under a heavy press. There seems to be a difference in the result of extraction according to the method used. Great care is necessary in all processes not to use too much heat, as this tends to destroy the odor.

We may say, in general, that wherever a plant is capable of yielding a pleasant odor, methods of extracting it and applying it to the manufacture of perfumes have been discovered. In many cases also the chemists have been able, by study, to find out the composition of the oils and essences that give rise to certain odors, and then to make these artificially in the laboratory, so that the flower odors or the perfumeries may be produced not only from the living plant, but from widely different sources.

It must not be understood that we have attempted to mention more than the greatest perfume industries, since there are large quantities of flowers grown for their perfume in South Africa, in Australia, and in favorable regions of our own country.

THE CELEBRATED EAU-DE-COLOGNE.

This especial perfume is a combination invented about two hundred and twenty years ago, probably by an Italian who, about that time, came to the city of Cologne, in Germany, where he established a business in selling what he called an *eau admirable*. At his death it is believed that he passed on the secret to a nephew, Johann Maria Farina, the first of that name which still is printed upon the labels of the bottles.

The perfume soon gained a very high reputation, and was from that time to this manufactured not only by the original family, but by other families bearing

the name Farina. Now the scent is sold throughout the world, and the name having been changed to Cologne, has been adopted as meaning perfumery, for the name Cologne by itself bears that meaning.

Some of those who make the article claim that it is still manufactured according to the receipt of the inventor. That receipt consisted in putting certain flowers and herbs, drugs and spices, into alcohol, distilling this by heat, and then adding still other vegetable essences. However, like most perfumeries, the cologne water has in various ways been imitated.

OTHER METHODS OF MAKING PERFUMERY.

By no means are all perfumes in liquid form. Sometimes the odor-bearing part of the plants is reduced to a fine powder which can be used dry and put into sachets, which can be laid among clothing. Sometimes the leaves of a plant may be used without preparation, as, for example, in the ordinary rose-jars, which consist mainly of the rose petals to which now and then various spices or scents can be added to make up an agreeable perfume-yielding jar.

The celebrated attar of roses consists of an oil prepared from the rose petals by distilling them or by one of the methods using oil or grease. It is made in Europe, at a great expense, and finds its use mainly in adding its delicious odor to various perfumes. Because of the enormous quantities of flowers used, and the long processes in extracting the oil, the attar itself is exceedingly costly and is very frequently adulterated.

This is the case especially with that which is considered the best; it is made in Hindustan, at Ghazipoor, where the whole country for miles around is little but a rose garden. Here they obtain the oil of roses by putting the petals into water, when the oil rises to the top and is skimmed off, giving the most valuable product, though the water itself is valued

because of the odor it carries. An ounce of the oil only is obtained from some 200,000 flowers, and an ounce is worth about forty dollars; or, if warranted genuine, it may be worth a hundred. Chemists have tried in vain to find some way of detecting when the true attar has been adulterated, but no method of doing so is yet known.

There are a number of perfumes which, in spite of the fact of their bearing the names of plants, are nothing but chemical imitations of the plant flavors or odors. Thus oil of apples and of pears comes from fusel oil; oil of grapes also is made from the same substance. A pineapple oil is composed of extracts from cheese and sugar, or a mixture of butter, alcohol, and sulphuric acid. Coal tar is constantly giving up to the chemist new extracts and essences, as well as drugs, and flavorings, and beautiful dyes.

A London newspaper, after telling of the ordinary process of obtaining perfumes, says:

“A much quicker way but by no means so thorough is that of crushing the flower heads in a mortar, adding blanched and chopped almonds to the petals in the proportion of half the amount of almonds by weight of the petals. The oil after a day or two will ooze out from the paste, which must be squeezed in a fine piece of muslin, the drops being collected in a bottle.

“In addition to the flower essential oils, there are several stock perfumes which, although they may be made at home to a great extent, are far more easily obtained from a chemist. This will save a good deal of trouble, such essences as musk, ambergris, oil of cloves, and other foundation aromas being troublesome to make and offering no advantages over the professionally extracted scent. A few drops of these are often used to make the perfume permanent, although to add too much is a great mistake and produces a common and overpowering scent.

“To make the essential oils which are the foundation of all, is the first matter. Once a row of bright golden, green and colorless oils has been secured, the work becomes a matter for leisure, for experimentation and original trials. Few perfumes nowadays are made of a single flower. There may be a predominating smell of verbena or of carnations, but probably four or five different blossoms have gone to make up the result and the interest in making the extract at home lies in allying one to another, experimenting with new combinations and aromas much as a chef toys with herbs and essences in the origination of a new sauce.”

PART II—Continued.

Section 4.—Dangerous and Harmful Plants.

CHAPTER XX.

Some Varieties We All Should Know About.

E have seen that plants may be useful in very many ways and that we could not possibly get along without these useful plants. But it is also true that some plants, many plants indeed, may be dangerous and harmful, as dangerous as other plants are useful. Even plants good to eat may be harmful if we eat too much of them, but some plants are dangerous to touch, like poison ivy and many tropical kinds, the juices of which have been used to poison arrows; some are deadly poison if eaten, like some kinds of mushrooms; some cause serious diseases like the microscopic little plants which cause diphtheria, pneumonia, and other kinds of sickness. We are used to hearing these plants called microbes or germs. Bacteria is the proper name for them. Then there are plants which are very harmful, not because they injure people directly, but because they cause diseases to the useful plants like wheat, the apple, and the potato. Such diseases are sometimes very serious, and may kill many thousands of useful plants.

PLANTS POISONOUS TO TOUCH.

Think what a queer feeling you would have in going into a strange house if you knew in advance that some of the chairs perhaps were so strongly electrified that to touch one would mean a severe shock!

Something of the same danger lurks in the woods and fields about you. There are several common kinds of plants which are more or less poisonous to touch. If you know them by sight you can easily avoid them, but if you do not, you may be surprised some time when walking through a weedy patch to feel a stinging sensation on your hands which have brushed against nettles. The feeling is not unlike that of a slight electrical shock, but it lasts longer and is more irritating. Or perhaps you may awake the morning after a tramp to find your hands and face discolored, and swollen and itching. You have probably been in contact with poison ivy, or possibly poison sumac.

These three are the only common plants in the United States which are liable to make trouble for most persons. But people with especially delicate skins are sometimes poisoned by rye straw. To some people, the beautiful little wild orchid, the yellow lady's slipper, is poisonous to touch, and other plants might be mentioned. Most of us, however, will be safe in the woods and fields if we know the three common kinds.

NETTLES.

Nettles are weed-like plants with slender green stems, and with leaves something like those of the elm tree. They often grow along fences or in other waste places, sometimes in the woods and in damp spots with the delicate jewel-weed whose leaves show silver under water. The poison of the nettle is carried in tiny hollow barbed hairs all over its surface. The barbed point itself is brittle and breaks off easily in the skin, letting out the poisonous sap. When you touch a nettle you may get hundreds of these little hooks in your hand at once. The poison, luckily, is not dangerous, but only irritating for an hour or so. It is usually safe to seize a nettle boldly and pull it up, for the skin on the inner side of the hands is thick, but beware of letting the stem slip through your fingers, for then the stinging barbs are sure to get in.

Our northern nettles are all small plants which are killed before winter; in the tropics there are kinds of nettles which grow to be trees, but their effect is not different from the smaller kinds.

POISON IVY AND POISON SUMAC.

Poison ivy and poison sumac are liable to be much more troublesome than nettles. With some people they may cause very severe and unpleasant results; with others the effect will be only slight, and still other people are not affected at all. Everyone who does not know positively that they will not hurt him should be very careful. The kind of poison is the same in both plants, so they are treated together here.

Poison ivy is a woody vine which will be met with often along fences, on old stone walls, and stone piles, and on tree trunks. Its leaf, like a clover leaf, has three seemingly separate leaf-like parts on a single stalk, each part something like a single apple or cherry leaf, for example, but altogether making what botanists consider a single leaf. Another vine which often grows with poison ivy, the Virginia creeper, has a leaf with five or more separate leaf-like parts. Then, too, poison ivy has small white berries; the Virginia creeper has dark blue ones. The country people have a saying "five to five and you are safe"; meaning, you may touch with your *five* fingers the *five* leaflets of the creeper, not the *three* of poison ivy. Another help is to remember that the *three* leaves mean the three letters i-v-y.

Poison sumac is a swamp bush, often rather tall, with beautiful dark glossy leaves, each consisting of a red middle stalk with several leaflets in a row along each side. This is something like the leaf of an ash tree, and the poison sumac is sometimes called "poison ash" on this account. Of course it is not an ash at all; neither should it be confused with many other kinds of sumac which are not poisonous. In the fall,

the poison sumac is one of the most beautifully colored of all our swamp plants.

The effect of the poison of both these plants may vary. If it causes considerable swelling and inflammation the best plan is to call a doctor. If it produces only a small brownish itching rash, bathe it in a solution of potassium permanganate which the druggist keeps. Some people have found relief by using gasoline. If used at the first feeling of itching, alcohol (spirits of wine) will remove the oil of poison ivy and prevent the poisoning. Wipe off the skin with alcohol diluted about one-third with water, and then wash the place with warm water. Do not use alcohol near the eyes.

THE UPAS TREE.

Poisoned arrows! The words suggest tropical jungles and naked savages, hidden in ambush. The practice of poisoning arrows has been followed in many lands, and the poisons used have come from many different plants.

Of these, the upas tree is undoubtedly one of the best known, and its poison one of the worst. The tree grows in Java where it is one of the largest trees, sometimes with an unbranched trunk sixty feet high. The tree itself, at least the bark, is not poisonous to touch, but if cut or bruised, a whitish sap oozes out which is very deadly; even its fumes are said to cause a rash on the skin, and if taken internally in food or through a wound, it kills with fearful convulsions. In poisoning arrows, this sap is mixed with several other substances to make a paste in which the arrow points are dipped.

Early travelers to Java believed the upas tree to be even more dangerous than we now know it is. The reports of its fabled prowess are like the stories about great giants as told in fairy tales.

“Fierce in dread silence on the blasted heath
Fell upas sits, the hydra tree of death.”

So wrote Erasmus Darwin, father of the world-renowned naturalist and philosopher, Charles Darwin. The poem tells further how "fell upas" was supposed to kill everything in its neighborhood, sometimes reaching up with a long branch to snatch an eagle in its flight, killing men by the thousands, and doing other marvelous and impossible things.

PLANTS DANGEROUS TO EAT.

All our food we get from plants—everything we eat. From the grains we get flour to make bread. From the cane and beet we get our sugar. Vegetables and fruit gives us starches and sugars of other sorts, as well as some proteid, or muscle-making material, and small amounts of acids and crystals in the flavors. But perhaps you are thinking, "How about meat? That's not from plants." Well, cattle live on grass and grain, and their bodies prepare from this plant-food the meat and milk we use. Chickens eat grain and give us the strength of this grain in eggs and meat. Thus with all our animal food—we can trace it all back to plants.

But of course not all plants are good to eat, and not all parts of some useful plants are good. Within the seed of peaches and plums is a very small quantity of a deadly poison, prussic acid. The amount in a single seed is too small to be harmful, but it does not take much to kill a man. The potato is one of the most wholesome of all plants when properly grown. If, however, a potato happens to lie partly out of ground, the exposed part turns green like the rest of the plant and develops a dangerous poison.

In fruits and vegetables the especial flavor is usually due to some kind of harmless acid or crystal, perhaps dissolved in the juice. In plants which are poisonous to eat, the poisonous property is also usually in the form of some acid or crystal. A few of the common plants which are dangerous to eat ought to be known better.

JACK-IN-THE-PULPIT

Everybody, I suppose, has heard of Jack-in-the-pulpit, one of our quaintest spring flowers. Sometimes it is called Indian turnip, and this calls attention to the fact that it has a thick underground part somewhat suggestive of a turnip. It is said that the Indians used to cook it and eat it. Perhaps so, but I can more easily believe that the name was given because they used it to torture hapless captives by making them eat it raw.

Certainly nowadays, the country boy likes nothing better than to torture his city cousin by persuading him to bite into one. Once tried, the taste will never be forgotten. The plant does not contain a deadly poison, but is full of tiny needle-like crystals which penetrate the tongue and inside of the mouth whereon they touch it. If you try to get rid of it by swallowing or rinsing the mouth, you only spread the stuff over a larger surface. The time I bit the effects lasted a couple of hours.

HEMLOCK.

In the days of Alexander the Great, the Greeks were wont to execute their criminals by making them drink the poison of the hemlock. This hemlock of course, is not the large forest tree, but a small plant something like parsley, which originally grew only in Europe but has since come into America as a weed. The great philosopher, Socrates, having been condemned to death, took it of his own accord.

HENBANE.

Henbane is a deadly little plant, poisonous to man as well as to chickens, as, indeed, to all animals so far as known except the hog. It grows both in America and Europe. Extracted and used according to a physician's advice, the poison is a useful drug. The Gauls who lived in central and western Europe at the time of the great Roman Empire, used the plant to poison arrows.

LOCOWEED.

“Loco” is the Spanish word for “crazy,” and locoweed is sometimes called “crazy weed.” It gets its name from its effect on horses or cattle which will eat it if good food is scarce. As it grows in the western United States where so much stock is raised, it may sometimes cause serious damage. Horses once “locoed” rarely if ever recover.

POISONOUS MUSHROOMS.

Do you want to know how to tell good mushrooms from poisonous ones? Or as probably you would say, “mushrooms” from “toadstools?” There is just one safe, sure way, and only one. You can not tell by trying to see whether the skin will peel off. Some bad ones peel very easily. Some good ones will not peel at all. Neither can you tell by testing with a silver spoon to see whether this is blackened. The only safe way is to learn to know by sight the good kinds from the bad, just as you have to learn to know your friends.

Most people imagine that there are many bad kinds, or toadstools, but only one “mushroom.” This is as far from the truth as it could possibly be. There are many kinds of mushrooms good to eat. The common kind we buy is, of course, whitish on top, and pink or purple underside, but some good kinds are red, some brown, some bright yellow, some green, some black. The common mushroom grows on the ground in sunny fields, but many good kinds grow in the woods, on the ground, or on logs or live trees. Some are tough and leathery, some are tender; some are dry, some very juicy; some one color all over, some two or three; some are spotted, some striped; some hairy, some smooth.

The poisonous kinds differ from each other in similar ways. One of the deadliest of all is clear white all over, and is called the “destroying angel.” Another fatal one is grayish, another brown, another bright

orange or yellow, another red. But there are not many poisonous kinds, and it is possible to learn to know the worst kinds and avoid them, and at the same time to learn gradually to recognize many of the hundreds of good kinds. You have only to look carefully to find that there are differences. A few of the worst are described below.

THE "DESTROYING ANGEL."

If in summer you should chance to find in some damp wood a rather tall mushroom with a pure glistening white cap and stalk, you have probably found the destroying angel. To be sure about it, dig down around the stalk and see if this is not set in a sort of cup at the base, and then look farther up and see if there is a loose thin ring of white tissue. The destroying angel has both the cup and the ring.

It is deadly poisonous, and there is no certain antidote known for it.

There is another mushroom which, like the destroying angel, has a cup and ring, but the top of the cap and the stalk are usually gray or brownish. Beware of this, too, for it has the same kind of poison as the white one.

THE FLY MUSHROOM.

The fly mushroom is bright orange on top with a few flecks of white scale stuck on. Like the two preceding kinds, it has a cup and a ring, and is also white underneath the cap. It, too, contains a deadly poison, but luckily there is an antidote for this kind if the doctor can be called soon enough to give it. The antidote is a plant poison itself, called atropine, but when it meets the mushroom poison, the two merely neutralize each other's effects.

The fly mushroom gets its name from the fact that it can be used as a fly poison by putting a little of it in a dish with sugar and water. It grows both in

Europe and America, and has been known since very ancient times.

It will be a good plan for you to avoid *any* mushroom which you find to have a cup and ring together with a cap which is white underneath. There are, to be sure, some of this sort which are good to eat—one in particular, orange on top like the fly mushroom, but different, and known as Cæsar's mushroom, was much esteemed by the ancient Romans—but there are several others besides the three described above which are also deadly poison, *and it isn't safe for any but an expert to try to tell them apart.*

Then there are a number of poisonous kinds which do not have the cup and ring. Each of these must be learned separately, as you learn to know one tree from another. After you have come to know the good from the bad, you will find a deal of pleasure in a tramp through the woods in quest of a mess to eat, and later, more pleasure, when they come from the cook, after having been nicely fried in butter.

PLANTS FROM WHICH USEFUL DRUGS ARE MADE.

Many useful drugs are dangerous plant poisons, that is of course, in too large amounts, or except as given by a physician. As a matter of fact, various patent-medicines are often recommended as being "made entirely from plants" but that does not mean they are harmless, because some of the deadliest poisons known come from plants. If they are to be used as medicines, it should be only upon a doctor's prescription, and, indeed, this is true of all strong remedies.

Opium and morphine, from the poppy plant, have eased many beds of suffering, but a slight overdose means death. Strychnine, one of the quickest and deadliest of all poisons, and from a plant, has many times served to keep the heart beating until a turning point of the disease could be reached. Quinine, a very

useful drug in treating malaria, comes from the bark of a South American tree. Castor oil comes from the castor bean, often cultivated for its foliage. Cascara is from the bark of a rather common shrub. But even to mention the names of all the drugs which come from plants would take more words than there are in this whole chapter.

PLANTS WHICH CAUSE DISEASE TO PEOPLE—THE BACTERIA.

There is another sort of harmful plant which really does more harm than any of those yet mentioned—I mean the bacteria which are responsible for so many of our worst diseases. Perhaps you are used to calling them “germs” or “microbes,” but the fact is, some germs are tiny animals, like those which cause yellow fever and scarlet fever. Bacteria are tiny plant germs.

They are present by the million almost everywhere, in water, earth, and air, in plants and animals, even inside our bodies. Many kinds are useful, but some cause the worst diseases we know. Colds, sore throats, typhoid, pneumonia, consumption, blood poisoning, and many others are due to different kinds of these tiny plants. We may think of them as poisonous plants which produce their poisons inside our bodies, just where these will do the most harm.

Sometimes the diseased bacteria come to us in impure drinking water, or in bad milk, sometimes flies carry them, bringing them to our food from the foul places where these insects are hatched. Malaria and yellow fever are carried by mosquitoes, but as it happens, both these diseases are due to tiny animal microbes, not to bacteria.

PLANTS WHICH CAUSE DISEASE TO OTHER PLANTS—THE FUNGUS PLANTS.

Lastly, another kind of harmful plants are those which live on other plants and cause diseases in them.

These are mostly various kinds of fungus plants, among which are included the mushrooms. Some fungus plants live only on dead plant or animal matter, like the mould on bread or that on cheese. Others grow in the living tree and come to the surface to form various kinds of mushrooms, or to form spots on the leaves. The rotting of fruit is due to certain kinds of these. When the leaves of the maple trees develop large tar-black spots, it is because of another kind. Around New York City, nearly all the chestnut trees have been killed by a disease caused by a fungus discovered only a few years ago.

Almost every year, one reads in the newspaper, reports of damage to the corn and wheat crops by smut and rust. Smut is a fungus disease which appears at the surface in the form of black powdery masses—sometimes filling an ear of corn. Rust forms rusty-colored spots on the leaves, and sometimes causes many millions of dollars of damage in a year.

PLANTS THAT ARE NOT HELPFUL TO US.

Since, in telling the story of agriculture and plant food, we are trying to cover nearly the whole history of man, we can not do more than briefly hint at some of the parts of the subject. Those who have studied plant life find it their duty not only to tell how helpful plants may be raised, but to give advice in the struggle to keep down or to kill, weeds and other unwelcome growths. Man has tried to spread abroad throughout the world, seeds of plants he desires, but in his journeyings, and in the movings of people from one region to another, it is found that despite the greatest care there will be transported the seeds that we would rather have left behind. You may have noticed that the seeds of the commonest weeds are those which are best provided with the means of securing a place to grow. Walk through the underbrush at the right time of year, and you will take with you the hooked seeds

of the stick-tights or of the burrs, and these are but one example out of many clever little travelers of the kind.

There is a little story telling that when the Roman soldiers went to England they brought with them seeds of a nettle plant, for it was their custom to rub and chafe their limbs with this when cold; and they were warned that the climate of the "Tin Islands" was not to be endured without much protection. This nettle for many years after spread in England, until it was common in certain places where the Romans were said to have landed.

The common plantain is said to grow only in settled places, and certainly appears soon after a region is civilized. The jimson-weed is another plant which seems to be commonest near man's habitations. The thorn-apple, a poisonous plant, is said by tradition to have come with the Gypsies from Asia, and to be found along the path of their wanderings into Europe. Wherever men go, it may be said, in general, that they carry with them not only those plants which they desire to cultivate, but an army of weeds against which they must unwillingly fight. Among these the thistle may be mentioned as a plant most difficult to keep out, and one that by means of its tufted seeds, carried far and wide by the winds, tends to overrun the soil wherever it is not vigorously kept down. Laws are made against the spreading of these weeds. and are enforced by fines.

USEFUL PLANTS THAT BECOME A NUISANCE.

It may be that the change from one region to another makes of a desired plant a pestiferous weed. In *The Great World's Farm*, a book by Selina Gaye, it is said that the delightful sweetbriar, a plant of which the English are fond, has so spread in Australia as to make whole regions valueless, because of the difficulty and expense of clearing them of its tangled growth. The prickly pear is another newcomer in

Australia, that, escaping from the gardens where it was planted, has covered extensive districts with a growth that is unmanageable. This and the Scotch thistle, the latter imported by some patriotic Scotchman, have come under the ban of the law, since the tropical climate has proved so favorable to them that they threaten to outgrow all reasonable bounds. The same author mentions a species of artichoke, the Cape-weed, and the common watercress, as plants that in their own homes were at least humble and unobtrusive, but in Australia have so prospered as to become proud and overbearing, or even threatening to the welfare of mankind.

So, together with the work in spreading plants there is also quite as important work to be done in resisting the spread of plants that are harmful, or that try to keep for themselves the land that we had rather see occupied by others more desirable.

PART III.

ANIMALS THAT MEAN MUCH TO MAN.

Section 1. Food Supplied by Animals.

CHAPTER XXI.

Dairy Products, Beef, Etc.

IN speaking of poultry we have already spoken of the eggs that form one of the most important elements of the food of mankind. It is well known that except for the very thin shell and the membrane or white skin just inside of it, every portion of an egg is packed tight with most nourishing materials. The chief parts are, of course, the yolk and the white, and these consist, the first of animal material deriving its color from a large part of the sulphur, and the other of almost pure albumen, one of the substances most necessary and useful in human food.

All of the egg is thoroughly digestible and nourishing, especially so when yolk and white are well mixed or thoroughly cooked. There is a notion that hard-boiled eggs are not easy to digest, but this is the case only when they are cooked too quickly and too long so that the albumen, or white, is hardened and difficult for the digestive juices to act upon.

There is no doubt that eggs have been eaten by mankind since the earliest times, and there is no likelihood that there will ever be a time when they are not regarded as delicious.

One of the qualities that makes the egg so useful

in the diet, is the variety of ways in which it can be cooked, and the great number of dishes into which it enters. In running through the receipts given in a cookbook, you will find that nearly every dish is made either lighter or more delicious, ornamental or appetizing by the addition of eggs. They can be beaten up into a light foamy substance or may be condensed into solid and most nourishing food. In a way they take the place of yeast by causing pastry to rise, and whenever used they impart a delightful rich flavoring. The white of the egg is also used in glazing food, and in fact there are few things, unless salt or flour, that the cook uses so often.

BIRDS' EGGS.

In order that they may not be crushed while the birds are sitting upon them, birds' eggs have a hard shell; to help in concealing the egg, when necessary, from its many enemies, it is provided with either a plain colored surface or one that is spotted or marked. It is interesting that where eggs are so laid as to be difficult to see, and therefore to need no protection by coloring, they are nearly always white. The first and simplest bird forms probably laid white eggs, as do the reptiles, and the colored eggs seem to have acquired this character later, for the reason given.

Of course, it is the eggs of birds that play the greater part in furnishing food to mankind, though a few reptiles' eggs, such as those of turtles, are also eaten in many countries. The hen's egg is nine parts food-stuff. Since nearly every farmer keeps poultry and uses the eggs for food, as well as selling them with the products of the farm, they are produced in enormous numbers in every country, forming a vast commerce. Although, for example, great numbers of eggs are raised throughout England, there are not enough to supply the demand of the towns, and therefore they are imported from Europe, and even from

North America, Africa, and elsewhere, the value of the eggs imported exceeding \$25,000,000.

In the United States the number of eggs produced has been constantly growing, especially in recent years when incubators, which relieve hens from the long sitting upon eggs, have caused them to lay more frequently. Thus, though there are no larger number of hens, the proportion of eggs has greatly increased, and the value of the eggs is far greater than that of the poultry. The annual output is not far from \$150,000,000, the price paid for them being on the average a little over eleven cents a dozen. If all the eggs produced in the United States in a single year were put into the cars of one train, this train would be long enough to more than reach from Washington to Chicago.

Nor is the cost of raising this valuable food material at all great, since in most cases the flocks of poultry are allowed the run of the farm and pick up their own living, without requiring much extra feeding by the farmer.

Of course, it would be impossible that the eggs could be handled profitably and carried to where they are consumed, as, for example, from the United States to England, unless there were methods known of keeping them from spoiling. In general, to keep the egg fresh it must have the air kept from it, which is done by putting it into brine, covering the shell with some grease or other coating that fills up its pores, or by keeping it in cold storage, that is, in a temperature so low that the animal life that would cause the egg to change and spoil can not develop.

It is a doubtful question whether eggs so preserved are quite so good as food after a long period has elapsed. Some experts say that there is really no difference so long as the egg is rightly preserved, while others insist that there is something lost, at least in flavor, and possibly in nourishment, or food value, by a long period of keeping.

OTHER USES OF EGGS THAN AS FOOD.

Enormous quantities of eggs are used in the arts, because of the albumen which makes a very useful and effective varnish, used largely in the preparation of photographic paper and of leather, to which it imparts a smooth and fine surface. Another industry that uses up great quantities of the egg albumen is that of printing calico, in which the albumen is used to fix the colors.

There are also various minor uses of the white of egg, such as in clearing sediment from liquor, and in affixing gold leaf to glass, to books, or wherever else gold leaf is used; but the eggs which are used as food consume nearly the whole product.

THE DAIRY PRODUCTS.

No young reader needs to be told that the three important products of the dairy are, in order, milk, butter, and cheese, the second and third being prepared from the first. Milk contains, together with a great quantity of water, small portions of floating fat, each enclosed in a tiny skin of albumen, the same chemical substance that is in the white of eggs.

So long as the milk is moved about, these little balls of fat, being nearly the same weight as the liquor in which they float, are scattered through it, but when the milk is left undisturbed, they float to the surface, and there gather together and form that richer and fatty kind of milk we know as cream. If this is skimmed off, what is left is known, of course, as skimmed milk and contains a watery liquid in which there is a curd or thicker part known as *casein*.

In order to make butter, the milk must be churned about so as to break up the little skins of albumen surrounding the balls of fat and keeping them from uniting. When broken up, the particles of butter gather together and gradually increase into a lump; this is removed, generally treated with salt, often



This illustration shows six of the most noted breeds of Cattle in the world. Beginning at the top of the picture they are: the Dexter; the Ayrshire; the Guernsey; the Holstein; the Shorthorn; the Jersey.

colored and flavored, and then becomes the butter sold in the market.

To make cheese, an acid substance usually known as rennet is put into the skimmed milk, causing the curd, or casein, to collect just as the fat collects to make butter, but this produces cheese. When the cheese has been thus separated by being tightly squeezed or pressed, the watery whey is caused to run off and the cheese becomes somewhat hard and dry.

Of all the kinds of milk, that from cows, of course, is by far the most important and the most widely used, but it is not the only milk employed as food for mankind. Perhaps next in importance comes the milk of goats or of asses, which differs slightly in composition; that of reindeer and of ewes, or female sheep is also used. From all of these can be made different qualities of cheese and butter. In India the milk of the buffalo yields a butter which is much relished there, and which is called "ghee." From ewes' milk, in France, is made the genuine Roquefort cheese, a variety that is highly esteemed in many countries. The Italian Parmesan cheese, when genuine, is not from cows' but from goats' milk.

PROOFS OF THE EARLY EXISTENCE OF THESE INDUSTRIES.

When the race, the Aryan, that afterwards gave rise to the highest civilization, was still little more than a collection of wandering tribes, we know that they must have been possessed of cattle, the meat of which they ate and from which they used much milk and butter. We are sure of this because, among the languages that have been derived from the old tongue, we find many household words that are taken from this use of cattle.

Thus in the ancient language, Sanscrit, a word of great dignity applied to the patriarch, or head of a family, had the meaning, "lord of the cattle." The

morning hours were spoken of as the time for calling the cattle, the evening as the time for milking. The Latin name for money, and the English word "fee," meaning payment, both go back to the root word that means "cattle"—an indication that these were then valuable and passed from hand to hand as money. In fact, the general name for property, down even to Saxon times was "cattle"—movable property being called living cattle, and immovable, dead cattle.

Besides this, it is believed that the word "daughter" originally meant "maid of the dairy." Nor are these the only words showing how early the idea of home and possessions was based upon the ownership and use of cattle. From this same early time come other words showing that the world meant to these people first, the wild land, and second, the fenced or guarded part, the "garden," in which were kept their animals and their cultivated plants.

Like all other industries, the making of butter and cheese, the gathering and the use of milk, were household affairs, and it was long ages before this work was done by certain families, or in certain places, with the idea of raising sufficient stock to be exchanged or sold to those who did not keep cattle or live where animals could be pastured.

Once the dairy became a commercial industry, and the farmers realized the advantage of having dairy work carried on in large central stations, there was the same development of scientific methods as in agriculture.

To what extent the industry has grown, every resident of a city knows. The milk is sent from farms, hundreds of miles away from the consumers, to stations whence it is carried by fast trains to distributing stations in the cities, towns and villages, and delivered to customers regularly in the quantities they order. It is not many years ago that the methods for doing this were crude and most objectionable. The old

method was to load great cans upon milk carts, and from these, by means of a long-handled dipper, to deliver into pitchers and other receptacles left for the purpose what was needed for each house. That method was wasteful, and, what was worse, exceedingly dangerous.

Milk, as is well known, is one of the best fluids in which to develop bacteria. It therefore needs to be handled by the daintiest methods, in order to be protected from the tiny germs that float, dust-like, everywhere in the air and are especially numerous in cities and towns.

Today, the places from which milk is sold are kept under Government inspection, cleanliness is required, and the milk must be carefully bottled or enclosed in other air-tight receptacles which are sealed, and so delivered in good condition. Even with the utmost care, it is most difficult to insure a clean milk supply, important as this is for the general health. So long as the milk is in its natural condition it can not be kept for many days unless it has been so treated as to make it impossible for germs to develop in it. There are several methods of bringing this about, usually by means of heat that kills the germs the milk contains, and so makes it safe so long as it is thereafter kept covered.

When milk is to be kept for a long time or transported long distances, it has been found that by boiling away much of the water it contains, by adding sugar or other harmless preservative, it may be canned, air-tight, and thus kept indefinitely. The invention of this method has been a great blessing for those who are in wild countries, on shipboard, or far from any sources of milk supply, since properly made condensed or evaporated milk, if used soon after it is opened, is entirely wholesome and palatable. Another method often used is to remove practically all the

water and produce thereby a milk powder which can be used either alone or may be mixed with other substances.

There are many most ingenious machines that will perform all the operations of the dairy work. Cows may be milked, cream separated, butter churned, cheese prepared and pressed, all by means of clever mechanisms, and with a great saving of labor. It results from this that more and more dairy work is being done in regular factories and less upon the farm. In the case of a product so easily spoiled as milk, it is of the utmost importance that it should be handled by right methods and in places that may be inspected by Government authority.

BUTTER AND CHEESE.

The United States produces nearly a quarter of all the butter which is made in the world, and consumes nearly a fifth of what is made. Russia, Germany, England and France, though they make much of these products, consume it all, and are forced to import from other countries. Canada is notably a great exporter of cheese.

The dairy industry in the United States has improved faster than almost any other sort of farm work. A matter of the greatest importance has been the importing of selected breeds of cattle which have been chosen as the best milk producers from all the world. The American machinery is also most excellent, and the fact that American farmers are used to applying manufacturing methods to their work has made progress in scientific dairying more rapid than elsewhere. We send abroad great quantities of butter, the larger part of which goes to England. Our dairy product is worth half a billion dollars, the larger part of which comes from the sale of butter, a little less than this being the value of the milk, and the rest coming from the sale of cheese.

HONEY.

There seems to be some doubt whether we should call the honey bee a "domesticated animal." The puzzle is to decide whether the honey bee is wild or tame, free or imprisoned. All bee-keepers know that unless carefully looked after new swarms from the hives may sail away and be lost, and by the modern methods great care is taken to secure the new swarms whenever they appear.

A swarming takes place only at special times, such as when a hive becomes overcrowded. So long as the queen bee remains in the hive the workers may be allowed to travel for miles in search of sweets and comb material, with the certainty that they will return. So the young reader must decide whether bees are wild or tame. They do seem to become used to the bee-keeper in some cases, but in others certain persons are never safe from attack, and if they go near the hives must be well protected.

But in any event, honey is a farm product, and, until sugar became cheapened, was a real necessity in the household, and is still a delicious luxury, the use of which is bound to increase, as commercial methods of putting it on the market and of bringing it to the attention of consumers are adopted. It is of great value in the diet, and has a flavor peculiar to itself.

Honey is, of course, gathered by the bees for their own benefit and stored for their own use. But, owing to the industry of the insect, who will keep at work so long as flowers can be reached and there is space to make and fill comb, an amount yielded by a swarm of bees can be made far to exceed any need of their own.

The value of honey as a food comes from its large amount of carbohydrates, that is, of the elements which yield warmth to the body. Besides this element there is a trifle of protein, the flesh-former, and much sugar that is easily affected by yeast (or fermented so as to make delicious drinks). In old times mead

and metheglin were exceedingly popular drinks made from honey, much used by the ancient Germans, and, until recently, among the English.

Before being replaced by the cheaper sugars, honey was exceedingly important in the home in the making of confections, and cakes, as well as for a sweetening.

The flavor of honey differs according to the flowers from which it is gathered. For example, the white clover honey is especially prized in the United States, and at a later time in the year the dark buckwheat honey is also very popular. Wherever flowers grow profusely, honey is sure to be produced in large quantities.

As is the case in many other industries, modern methods have greatly improved bee-keeping. Formerly it was the custom, after the hive was filled, to kill the bees by the use of smoke or sulphur, which in our days seems foolishly wasteful. In modern times it is not necessary either to kill the swarm or destroy the hive in order to get out the honey. The hive is built with movable frames that can be lifted out and replaced by empty ones. Work is saved to the bees by providing them with artificial comb ready to be continued without the making of a foundation. When a swarm grows too large for a hive, it can be removed to a new hive or divided among several.

Bee-keeping has also been improved by the importation of choice varieties of bees, the Italian queen bees being especially valuable for the modern hive, since they are good workers and their progeny is better-tempered than the American variety.

It was a scientific man who gave the hint for the improvement of the honey industry, a blind Swiss by the name of François Huber, most of whose studies were made by the help of a servant who acted as his eyes and reported what he saw. Upon Huber's studies of the hive and its inmates, are based the great modern industry of honey-making. More honey is raised in the United States than in any country in the world and

it sends a great quantity abroad. Ten years ago the swarms in the United States were worth over \$10,000,000, and the annual product was worth nearly \$7,000,000.

Besides the honey, we must by no means forget to mention the importance of the wax as a product of bee-keeping. Its principal uses are in the making of candles and matches, to polish and preserve wood, to make a certain cement used by chemists, and by painters to mix with their colors, especially in oil paintings.

Sculptors frequently use wax for their more minute works, and there is a means of casting in metal known as *cire perdue* that enables the metal-worker to make exact copies of very complex forms. In this the Japanese are especially skillful. A form is modeled in wax, and then covered with clay. Upon baking, the clay is hardened, the wax melted so as to run out, leaving within the clay mould an open space exactly reproducing the form of the modeled article. The hardened clay mould may then be used for casting in metal. By this means the most delicate forms may be exactly followed.

Modeling in wax has given rise to several minor arts, one the making of portraits, which has been in use since the most ancient times, and another the making of wax figures, either for exhibition or for advertising purposes. These are especially striking because of the resemblance of the carved, colored and modeled wax to flesh.

Another use for wax modeling began several hundred years ago, in Italy, when a famous modeler made, for scientific purposes, wax models to exhibit the appearance of the body or parts of it in health and in disease. Collections of this sort are now frequent in many great cities, and are most useful to medical students.

The making of wax flowers was also once exceedingly popular, but is now not often practised. In all

these cases the fact that the wax can be colored to any hue, that it is easily shaped, and that it will retain its form so long as it is not warmed, has made it the best material for the purpose.

MEATS.

In telling about plants we have said that the chief part of their food consists of minerals, whether derived from the air or from the earth, for in this sense chemicals are included as "minerals," because they do not have life. Many animals, however, as you know, feed upon other animals, and such species as have this habit are known by the fact that their teeth are so shaped as to show they are ready for catching animals or for tearing flesh, that is, they are sharp and pointed, instead of flat, for grinding. Though it is probable that the far-away forerunners of man were fruit and vegetable eaters, as are the apes, yet that he has for countless ages eaten meat also is considered proved by the fact that some of his teeth are so shaped as to be fit for cutting and tearing.

At all events, we know that there is hardly anything that will help sustain life, that is not eaten by the lowest savages. The Australian blackman, for example, is very fond of insects that are found in the trunks of trees, and of other small creatures, to the eating of which civilized man has an aversion.

Savages, therefore, with the few things that they find too harmful or troublesome to eat, live upon all forms of animal life, and are exceedingly clever in devising traps, snares, pitfalls, and other ingenious ways of catching animals. In addition to those which they secure by hunting, probably the lowest animals to be tamed were secured while they were young, much as Robinson Crusoe began his taming of animals upon his island. Being caught young, and becoming used to man, they soon lost their fear of him, and growing up under his care, showed that they were able to live and thrive, although fenced in from the wild life.

It was so plain that it was easier to keep and breed animals where they could be taken whenever needed that the taming and domestication of animals for food began long before there was any real civilization, and is found among savages who have at all advanced beyond the lowest stages of life.

It is possible that the first animal thus tamed was the dog; but though he may have been kept for food, the dog was really too clever and too interesting, and made himself too useful to be long treated merely as a food animal. It was only the gentler and more easily tamed animals that were not very intelligent which continued to be kept in flocks and herds mainly for eating. Thus it has come about that the chief animal food used by civilized man are cattle, sheep, and swine. Though bulls were fierce enough, the cows were not difficult to tame, and the bulls could be controlled.

Sheep also were of gentle disposition and accustomed to go together in flocks, so that they were easy to care for and to keep from straying. Although the swine, in the case of the boars at least, were both clever and fierce in the wild state, yet the pig is an animal that, when it is made comfortable, and especially when it is fattened, can be handled without difficulty.

Although we are not sure but that many other larger quadrupeds might have been tamed, and would have furnished good meat for the table, yet, all things considered, men have found out that these three furnish most excellent eating and serve all the purposes of domesticated live stock.

THEIR CHANGES WHEN TAMED.

So far as we know the history of cattle in general, the size seems to be very subject to change under different conditions. Among the wild cattle some grow to very large size, but those that were domesticated were, at the time when we are first able to read about

them, considerably smaller than the average nowadays.

The methods of caring for the animals during the winter months were not then well understood. The cattle were with difficulty fed at all, and nearly always came out from their winter shelter to the spring fields in a very run-down and feeble state. An animal so treated is not apt to grow to full size and maturity, and the old half-wild and poorly cared-for animals of the British Islands, for example, were much smaller, leaner, and, altogether, considered as farm stock, far inferior even to the ordinary cattle of today.

In speaking of the supply of milk in the United States, we have said something of the great benefit derived from an importation of choice cattle, and a similar process of improvement by caring for the choice varieties and using them to breed from has now not only improved cattle in size, in flesh-making, in the proportion of milk, but has also brought about the growing of species, each adapted to some special good quality.

Thus, some cattle are bred as meat producers, and are so shaped and filled out as to carry the largest quantity of the most nutritious meat. Others are bred for the dairy, and give great quantities of milk of the richest consistency. Cattle are bred to be hornless, to be hardy, for a sleek coat, a gentle disposition—and, in fact, the breeder, by selecting the parent cattle, can be sure that the young calves will be very likely to improve in any direction he wishes.

So also it has been with their numbers. Rightly cared for, kept in proper yards or allowed to roam in rich and secure pastures, watched over so that they will not be disturbed by wild beasts, skillfully treated for such diseases as may arise, and protected from the spread of disease by the removal of infected cattle, the herds of cattle and the flocks of sheep, the droves or pens of swine can now be increased in num-

ber almost at will and in accord with the demands of the market.

To realize the change from earlier days, we have but to think that only a few miles away from the centers of population, that is, from the big towns and cities, the farmers of old times were in danger of having their stock driven away by mounted robbers too strong to be resisted or to be overtaken and punished by the few Government officers. If, in those same old times, animals upon a farm sickened, they might all be swept away without the owner's being able to find out what was the trouble or to check the spread of disease.

In regions where, nowadays, broad farms may produce their crops in peace and cattle winter safely, not so very long ago the only security against wild animals or human thieves was in the constant watchfulness of the armed owners.

THE MEAT AND PACKING BUSINESS.

Another inconvenience that came from the raising of bunches of cattle here and there in small lots lay in the difficulty of having a ready and daily supply of meat for the family table. It was not easy to keep meat, once the animal was slaughtered, and you may read in the early story of the United States, or you may even today see in remote regions, how, in order to provide that there should be a quick use of the slaughtered beef animal, the butcher went about, or goes about, to various houses finding which will take this portion or that.

Naturally enough, a good deal of the meat, especially the poorer parts, even then must be wasted, since no one was likely to want the poorest pieces. As a result it often happened that cattle could be slaughtered only at long intervals, and during the rest of the time many farmers had to live for the most part upon smoked or salted meat.

Here again the great principle of working together came in, and as the country grew and people settled more and more closely together, it was found best that there should be men who gave their time to the buying of large quantities of cattle, of selecting this as a business, of taking and preparing them for sale, so that every butcher-shop throughout the land might be supplied with just the right amount of the different kinds of meat needed to serve the neighborhood.

This proved a great economy. Not only did it provide for the best parts of the cattle, but when they were brought together in such quantities it was worth while to prepare for one purpose or another every part of the selected creatures, from horn to hoof, and use was found for each portion. From the hoof glue was made, and the bones were turned into fertilizers or formed into buttons and tool-handles, so that everything found a sale.

This was an industry that helped all connected with the cattle business. Once sure of a market, men could raise thousands of animals upon the wide, open lands yet unfit for farming, and were sure that at the right time of year the herds would find a ready market at the cities where the great packing houses were in operation.

To bring the cattle from range to market are needed, first, the cowboys that have cared for the herds and now drive them over long trails and roads to the nearest railroad station. Here great cars built for them are loaded and take the cattle sometimes thousands of miles, delivering them into the stock-yards so that they may be slaughtered and treated in the manifold ways that make them ready for market. Thus the handling of the cattle, the freighting of them, their collection, the preparation of them for market, has given rise to work that employs thousands of men, and indeed gives support to numberless families that in their turn employ others.

MEAT OF WILD ANIMALS.

We have already suggested a reason why certain animals have been chosen to supply most of the needs of civilized peoples for meat. Of course there is no such reason against the use of other animals by peoples that yet are in the habit of depending upon hunting for their meat supply. They are able to kill, in most countries, enough meat for their immediate use in any region where their wandering life leads them, and therefore need not take the trouble to tame herds or be careful to use all portions of the meat.

It follows that the savages and other wild hunters are apt to be wasteful, giving rise to the saying that among many wild peoples it is apt to be either "a feast or a famine." This does not mean that they are not at times careful to smoke the meat, to pound it up and prepare it with fats, or to dry it in the sun in hot countries, or otherwise to preserve it, but even so they are seldom able to prepare any very large stock, owing to the difficulty of carrying it about, and so enjoy a season of plenty when they happen upon frequent herds, or, in the season when hunting is easier, and then when winter drives the herds of animals perhaps into some inaccessible place or deep into the wilderness, a season of famine is only too apt to follow.

It will easily be seen that in order to support these wandering peoples and to provide food for the animals upon which they live, enormous tracts of country must be left wild, so that when one region is exhausted both animals and men may find support in another. This did not matter so long as the land was unsettled and vegetable life was not interfered with. But it was a wasteful use of the land that could not go on as more people settled the wild country, making farms and towns and villages that must be supplied with food and so made it necessary to be saving and systematic.

Therefore the wild tribes that once were found in nearly all civilized countries have been forced either to adopt ways of civilized folk, to move into wilder regions if possible, or simply to die out, because there was not support for the animals upon which they lived.

In reading of the early times in America, for example, travelers upon the great plains frequently met with herds of deer and sheep, with countless numbers of bison, and could secure meat with little trouble. The whole race of Indians that lived on the plains had learned ways of living that made them dependent upon the bison for nearly all their necessities. Not only did they live upon its meat, but they made their tents and their tools and implements from parts of this animal. They need not live in any fixed place, but could follow the wandering herds of bison along the great trails that were trampled into the prairie soil by the passing of untold thousands, one after another.

When white men came with their better weapons, and with the possibility of selling the buffalo hides to the settlers, a shameful slaughter of these creatures took place, and despite the myriads that blackened the plains, the bison has now become a rarity, only a few individuals being kept in parks. In the same way most of our American wild animals have been destroyed, those that remain being either preserved in remote regions or in deep forests, or such as, being harmless, have been protected.

Thus it has come about that venison, or deer meat, the meat of the bear, the prairie chicken, and a dozen other animal foods, once common, are now rarities or only to be secured by hunters during seasons when the law allows them to be pursued. Today, if we would have any but domesticated animals, they must be carefully protected and provided with suitable places where they may live undisturbed.

CHAPTER XXII.

Birds and Game Birds.

“CHICKEN”—ITS MEANING.

IT is a curious circumstance that words will not keep to one exact meaning, and this is shown in our own time by the use of the word “chicken,” and in times farther back by the word “bird” itself, and also “fowl.” As you may see everywhere, people speak of chicken or chickens, meaning both the young and the older birds of the poultry-yard. Only those who are very careful in their language remember that chick and chicken applies to the young fowls. It will not be very long before the ordinary use will become the correct one, and the word chicken will mean simply fowl, where it once meant only chicks in the plural, that is, a number of young taken together.

This would not be very important except that the same thing is true of the word “bird.” This once meant only the young of an animal, according to one authority, and it quotes an old act of the Scottish Parliament which calls wolf cubs “wolf *birdies*.” The common German word for bird was “fawl,” which now has only a limited meaning in English. The old Anglo-Saxon term, “bird,” meant a little or young bird. The word fowl itself is changed from the German *vogel*, which meant any bird, but, in English, fowl is especially applied to poultry, except when used in such combinations as sea-fowl, land-fowl, where it keeps its old meaning.

WHERE CHICKENS ORIGINATED.

The parent stock of our barnyard poultry is commonly thought to be the Red Jungle Fowl of India,

which is still widespread, not only in that country, but throughout many of the islands in neighboring seas. Its home, by choice, seems to be in the forests and underbrush, but it is said to come out in flocks to feed in cultivated fields near its native haunts. The cock crows, after a fashion, its cry being sharper and not so long sustained as that of the domestic bird.

The Javan jungle fowl, while closely related, is not the ancestor of any of our domestic breeds of poultry, and is distinguished from them by several important differences. This wild species has the neck feathers, or hackles, square at the tips, and has but a single, middle wattle, instead of one on each side of the face. The comb and wattle are wonderfully brilliant in color, and the comb is not notched, as in domestic poultry.

It is thought fowls were first kept in a tame condition in Burmah, or nearby, and the traditions of the Chinese say that their poultry came to them from the West three thousand years ago. A code of laws nearly as old forbids the "eating" of tame fowl, which is taken as proof that flocks of them were plentiful. Possibly the law was meant to preserve the tame ones as egg-layers.

IN ANCIENT TIMES.

Neither the Old Testament nor Homer mentions these birds, and they are not seen among the Egyptian sculptures or writings, though many sorts of animals are pictured, but they are spoken of by Greek and Roman authors. From early times men have been impressed by the spirit of the cock, and have taken it as an emblem of courage. The Romans made this bird sacred to Mars, the god of war, and it has come to be an ensign in war, especially among the Gauls and their successors, the French nation, and also in Christian art, where it is drawn to symbolize the Resurrection. This has come about through its connection with daybreak.

THE KEEPING OF FOWLS.

The *Encyclopedia Americana* well says that the keeping of poultry is an "old art and a new science," which means, of course, that while poultry have been kept from earliest times and cared for by a certain "rule of thumb," the older people teaching the younger what they learned, it is only within about thirty years that the knowledge about poultry has been put into such shape that it may fairly be called a science. There are two reasons why they have been so carefully studied: first because of their importance as food, either as egg producers or for their meat, and, second, in the fact that poultry so easily change under the care of breeders that they can readily be made to take on new forms or colors. Thus the breeder has brought about the great difference between the brahma, sometimes weighing twelve pounds, and the bantam, whose weight may not exceed a pound. The differences in plumage are well known to every one.

THE MANY VARIETIES.

Many different kinds of fowl can be produced. They can be raised especially for eating, or for laying eggs; yet all these have been raised within what may be considered a short time from, at most a few wild species. And whereas many fancy varieties do not last among certain animals, numerous poultry varieties can be preserved. At present, the domestic fowls on American farms produce more than a hundred and fifty million dollars worth of poultry, and half as much again in worth of eggs. This covers only those that are marketed, so that it is believed that the whole worth of the poultry consumed yearly in America reaches half a billion dollars. Thus the poultry product is greater in value than any except that of the dairy and dairy animals. The eggs of a single year are worth more than all the gold and silver we produce.

Perhaps the most striking examples of the effect

of breeding for plumage are the enormously long-tailed cocks which have been bred for many years for the purpose of increasing the length of the iridescent, curved, ornamental feathers of the tail. These may reach from twelve to twenty feet in length. Such long-tailed fowls have been bred for nearly a thousand years, in Corea. They illustrate how birds originally kept for food may become mere curiosities, bred to excite wonder.

There are nearly a hundred varieties which are recognized by fanciers. The object is to produce fowls combining the power to yield many eggs, to be good eating, and to care for the young successfully. The poultry books tell us for what quality each variety is desirable, and raisers select those which will best serve the markets in their localities. These varieties have come about by careful selection and breeding of birds that have shown themselves valuable.

THE GAME FOWL.

The game fowl is a descendant of the red jungle fowl ancestor that closely approaches it in form and color. It has been bred particularly for its fighting qualities, is trimly built, with long legs and spurs. A fight between game-cocks is a very wonderful performance, from the fact that they are so expert in the use of their spurs, the bird leaping high into the air and striking a downward blow with great quickness and precision. When game-cocks are allowed to fight naturally, they seldom kill each other, but when they are trained for professional fighting, long steel spurs are fastened over the natural weapons, making them formidable indeed, and capable of inflicting mortal wounds. These birds seem to take an instinctive delight in combat, and this propensity has been cultivated to such an extent that they will attack hawks, foxes, and even larger animals, including man himself.

THE BANTAM.

The bantam is another variety whose relationship to the jungle-fowl is also very apparent. While smaller, it is quite as pugnacious as the preceding form, the little creature carrying itself with a most spirited and defiant air. It is very amusing to see a tiny bantam rooster walk up to an enormous cochinchina cock, and, with a significant crow, leap into the air and strike a blow at the head of the larger bird which immediately discourages the giant and puts him to flight. After which the bird David flaps his wings and crows his loudest in token of victory over Goliath. The bantam is of little economic value on account of its small dimensions, but is of interest to breeders as a fancy variety. These dwarfed forms have been produced from several of the domestic varieties of fowl, but the earliest and best known appears to have been derived from the game-fowl.

STARTING A VARIETY.

The starting of a variety often depends upon finding some individual bird that is better than others in a certain respect, and after a variety has been shown valuable for a certain quality it is the object of the breeder to supply the other qualities needed to make it good in all respects alike. There are certain elements of artistic pleasure in the appearance of fowls that cause breeders to seek those of striking beauty of plumage, although in this respect the domesticated birds are far surpassed by their wild ancestors. It has been found that fowls of white plumage are more likely to find a ready market as poultry.

In some kinds of fowl no attempt is made to combine several qualities. They are bred, for example, as meat fowls, egg-layers, or simply as fancy breeds that please amateurs. Some of the varieties that are considered best for the table are the Indian game fowl, the dorkings, the brahmas, and la fleche. With these

may be mentioned also as best "for general purposes," the Plymouth rocks, the Rhode Island reds, and the Orington. As layers of eggs, the Hamburgs, Leghorns, and Minorcas are preferred.

Those varieties which are valuable to the farmer are but a few in comparison with what might have been developed, had man chosen to breed from other stocks, for there are still found in their native countries species quite different from the ones that have been tamed. If not for food, some of these certainly would give rise to varieties useful or interesting to the fancier.

The wild ancestor of the barnyard fowl laid few eggs, and was a small, thin bird, while we have already told of the great weight attained by some of the domestic varieties. Those that are specially bred for their eggs lay a far greater number than of the wild species.

INTELLIGENCE OF FOWLS.

The barnyard fowl is the only one of its order that has been thoroughly tamed, and this is explained by Professor Shaler as coming from the fact that it had, when taken in hand by man, already given up the power of flight for long distances, using its wings only to escape pursuers or to reach its roosts in the trees. Being unable to fly far, the fowl became accustomed to living without going far from one place. Even in their wild life, too, they had learned to keep together in flocks, whereas other birds of this kind separate as soon as the young can take care of themselves. Professor Shaler says also that they are kind and sympathetic with one another. They will fight for each other as against hawks; the hen will not desert her brood; and the cock will often call the hens to eat something nice that he has found—but it is fair to say that he sometimes selfishly snaps up the titbit before any of the hens can reach it. Whether this is a humorous

trick, or a sign of pride, we do not pretend to decide. All these traits seem to show intelligence. Another sign of their cleverness is the many calls they have to express what they mean, and which, to one accustomed to hearing them, are quite readily understood. Such are the cackle of the hen after laying an egg, and the clucking sound she makes as she gathers her chicks about her. Another distinct note is the call of the rooster when he has found some morsel that he wishes to share with the hens (as already mentioned), and the cry of warning when he sees danger overhead in the shape of a hawk or owl—an alarm that sends the fowls hurrying to cover. Another unmistakable sound is the so-called “singing noise” made by a number of fowls on a warm day in spring or summer after being fed. While not strictly musical, this note seems to be a genuine attempt at song.

This ability to convey meaning helps to keep up a common feeling in the flock, and makes them act together. It is not meant that they reason in any true way, but that they can communicate their feelings to some extent. Fowls have a sense of place, and do not often get lost, and they seem, like the dog, willing to live with man, although it would be easy for them to provide for themselves in mild climates throughout the year. The effect of their taming, besides changing the color of their plumage, has made them stronger and less brave; they multiply more rapidly, are gentler, and more intelligent. Except where trained for fighting, as in the game cocks, the tame birds are much less quarrelsome than the wild species, though the fighting instinct is still evidently present.

VALUE OF POULTRY AS FOOD.

The chief value of poultry as food is in the fact that it contains very little refuse. It also is less fat than animal meat, and therefore produces less heat. It is, in a word, more nourishing and less stimulating

than other meats. There is a popular idea that the light and dark meats differ considerably, but scientific men find that there is no difference worth considering in their nutritive and digestive qualities. As regards cost, the ordinary kinds of poultry rank in value with beef, mutton, and pork, and poultry or game at fancy prices are among the most expensive of all food. The advantage of the farmer in raising poultry lies in the fact that it may be fed from materials that need not be expensive, as they live largely on scraps and waste food. Those who have studied the subject believe that it would be wise if poultry formed a larger part of our daily fare, since it would give much more variety, and a larger demand would make poultry cheaper.

THE TURKEY.

America has given us but one valuable domestic bird, the turkey. Known only wild in this country, it was introduced into Europe by the Spaniards, and afterwards brought back to America as a domestic fowl. Like the barnyard fowl, the turkey goes in flocks, but, unlike them, it is apt to become wild if not carefully kept on the farm. Indeed, it is not uncommon in some parts of the country for wild birds to mingle with the domesticated flocks.

The coloring of the male turkey is very beautiful—a deep golden bronze, highly iridescent in certain lights, showing a considerable amount of red and green on the body. The tail-feathers are brownish red, banded with black and white. The coloring of the female resembles that of the male, in general, but has much less iridescence. The Mexican wild form, from which our domestic bird is a descendant, has the tail-feathers lighter in color than the eastern wild species, but otherwise they are much alike.

In certain characters the turkey differs from all other known birds. The head and neck are bare and

brilliantly colored, and when the bird is excited or angry the skin becomes suffused with a deep reddish tinge. A long fleshy wattle hangs from the base of the bill, and from the middle of the breast grows a bunch of coarse stiff hairs, four or five inches in length, the use of which is unknown.

THE TURKEY ON PARADE.

In displaying, this bird is a truly wonderful sight. The wings are lowered and held stiffly at the side, brushing the ground, the feathers on the back are raised, and the tail feathers are raised and spread to the fullest extent. The head is thrown sharply back into the neck feathers, and in this position the "gobbler" gives the curious call so characteristic of his kind, and struts about in the most majestic manner, the scraping of the wing-feathers along the ground producing a dull booming sound that appears to come from a distance. Although so large and heavy, the turkey flies with great speed, and in the wild state flocks of them roost at night in the tops of tall trees.

The female often hides her nest very skilfully, preferring not to lay near habitations or in places prepared for her use. In fact, turkeys seem to thrive best where half-wild land is plenty. The young are very delicate for some time and difficult to raise, but after the early stages are past and the down is replaced by feathers, as the young approach maturity, they become much more hardy. The hen is a most anxious mother, ever on the lookout to protect her young from their enemies—birds of prey and foxes especially—but taking them on long walks in search of food and dragging them over marshy ground, so that they frequently perish from cold.

Considered simply as a food bird, the turkey is by far the most valuable of the ornamental fowls. When they were first met with by the English in America, these large birds made such delicious eating, and such

good sport in hunting, that they became very popular and were early adopted as the main dish at times of feasting. Thus it is that in America the turkey is traditionally thought of as the chief attraction of the Thanksgiving feast and a valued part of the Christmas dinner. It took the place in the minds of the settlers among the English that had been occupied by the roasting-pig, the fat Michaelmas goose, and, farther back in history, by the boar's head and the peacock, so long associated with grand banquets.

THE PEACOCK.

The common peacock, so called, is a native of southern Asia, and though particularly tamed for thousands of years, it has changed very little in form and color. It is perhaps the most marvelously colored of all feathered creation, and is raised in this country chiefly for its beauty of plumage. In India it is used for food, and is also hunted by the rajahs and other potentates for sport. Owing to its disposition to wander, it is difficult to raise except on large places. The peacock is not so intelligent as the common fowls, is more quarrelsome, and its "language" is much more limited. In captivity this bird is very conspicuous, but in the wild state the brilliant coloring is no doubt "protective," the odd patches of color helping to deceive and perplex the eye.

The train of the peacock, usually called the tail, but really the feathers of the lower part of the back, reaches a length of five or six feet, and can be raised and spread in a great semi-circle. In color it is extremely complicated and beautiful, each feather terminating in a broad web containing a large eye-like form, and the whole train shimmering and glowing in prismatic colors. The attitude of the peacock in strutting is somewhat like that of the turkey, with the head bent sharply downwards and backwards, the train raised and extended, supported by the true tail-fea-



GOLDEN PHEASANTS.—The pheasant is a famous game-bird of England; numbers of them have been introduced into America. It came originally from Asia; the golden pheasant of China is a gorgeously beautiful bird—all scarlet, blue, black and yellow, and with a golden crest.

thers, and the wings hung loosely at the sides. In this position the bird turns slowly about, as if showing off for the admiration of beholders. Its harsh and discordant cry comes as an unpleasant shock to one who is wondering at the beauty of its plumage.

THE GUINEA FOWL.

The guinea fowl, originally from Africa, is much like the peacock in disposition, never becoming more than half tamed. It is a very peculiar looking bird, having a very small head, bare, and surmounted by a hard bony cap, resembling a helmet. The head is carried low, and the back is arched, producing a hump-backed appearance. The general color is gray, delicately spotted and streaked with white, forming a complicated and beautiful design. This bird is found, in America, most frequently in the southern States. It has no great popularity as a food bird, and does not seem to be valued in proportion to the deliciousness of its flesh. The guinea-hen lays many eggs, but, like the turkey, hides her nest.

This bird is very shy and suspicious, and extremely noisy, uttering almost incessantly its disagreeable cry, which has been likened to the words "Come-back! come-back!"

THE PHEASANTS.

Not all imported birds have, like the English sparrow, proved undesirable additions to our native species. Enormous numbers of pheasants have been brought into Oregon and other parts of this country during the past ten years, and as they live chiefly on harmful insects and wild berries, their introduction has not been opposed by the farmers.

The bird known as the English pheasant is the one that has been chiefly domesticated. Its original home was Turkestan and other parts of Asia, and it is very similar to many forms now found in China. This

pheasant is supposed to have been introduced into England by the Romans; at all events, it has been bred in that country for many centuries, and is regularly shot in the hunting season by sportsmen who preserve the birds for this purpose. Hundreds of thousands are raised every year in England alone, and the eggs bring good prices in the markets. The birds are provided with suitable cover, trees and bushes being cultivated in private parks for the purpose of affording the necessary protection during the nesting season. As soon as the chicks are hatched, they are placed under domestic hens, which have proved to be more satisfactory than the pheasant mothers. The hen is put in a coop on the ground, while the chicks are allowed to run at large in the vicinity. The young birds are fed and cared for until they are old enough to provide for themselves. They are extremely shy, even from the first, and one is amazed at the facility with which the little creatures, when approached, conceal themselves in the nearest cover.

This bird is now common in many European countries, as well as in Great Britain, and there seems to be no reason why it should not thrive in most parts of this country. It grows to a considerable size, the meat is a great delicacy, and the bird itself is not injurious to crops. It is also extremely hardy, and is able to endure very severe weather.

In coloration the English pheasant is wonderfully beautiful. The whole body is covered with a glittering iridescence, dark greenish upon the head and neck, while a lovely brownish color extends over the breast and back. On each side of the face are patches of bright red skin, and curious little tufts of feathers grow from the sides of the head at the back. The female is much smaller than the male, and is dull in color.

There are many other species of pheasants, beautiful in form and color of plumage, but none has been



GROUSE.—1. Prairie Hen. 2. Blackcock. 3. Moor-hen, or Ptarmigan, in winter dress. 4. Scotch Red Grouse. 5. Ruffed Grouse. 6. Hybrid between Blackcock and Capercaillie.

so successfully raised in confinement as the preceding. They are not used for food, therefore, but are as a rule kept by fanciers merely as ornamental birds.

Other game birds are not preserved on quite so large a scale as the pheasant, yet, in the older countries of the world, land-owners leave untouched fields and woods suitable for the choicer varieties. Into these preserves parties of hunters go at the proper seasons, and by the use of decoys or beaters drive the birds from cover in order to enjoy the sport of shooting them in flight. There is a plentiful amount of information, interesting chiefly to sportsmen, regarding the haunts and habits of the different species which are most valued for the table. As a rule, these birds have acquired habits which make them difficult to shoot. Either they are so colored as to escape the eye and can be hunted only by the aid of dogs trained for the purpose, or they are so timid or so swift in flight that even when they are driven from cover, it requires a good marksman to shoot them. They do not form so important a part of the food of mankind as to be worth much discussion, being looked upon mainly as giving subjects for the skill of marksmen. Among these are included the partridge family, consisting of the grouse, quail, and ptarmigan, as well as other birds that are now and then hunted by sportsmen.

But in this chapter we are considering birds mainly according to their value as forming part of the food of mankind, and it is really only the domesticated varieties which are very generally eaten.

THE PIGEON.

Among the free-flying birds, the only one really tamed is the pigeon, a descendant of the blue rock pigeon of Europe and Asia. The breeding of pigeons has been carried on for more than two thousand years, and has resulted in the production of beautiful varie-

ties of plumage and certain interesting habits. Two things have made this bird a favorite with man. One is the fact that the young is hatched in a helpless condition, and both parents take part in caring for it and feeding it with partly-digested food from their own crops. Being thus compelled to care for their young, the mated pigeons remain together for life and with their young constitute a true family.

The other characteristic is the power to change to beautiful varieties which are permanent because of this mating habit. Some odd results of special breeding are the fantail pigeon, which has a tail that can be spread; the pouter, which is able to swell up its crop with air until it looks like a drum major; the tumbler, which seems to delight in turning somersaults in the air; the crowned, and the ruffed pigeons, ornamented with tufts of feathers upon the head or around the neck. The marking of pigeons is endless, and there is hardly any beautiful color or luster which may not be seen in some specimens. One variety has become known as the homing, or carrier pigeon, whose certainty to return to its home has been made use of for the carrying of messages, as is mentioned in another part of this volume. These birds were to past ages what wireless telegraphy promises to become to us—a means of sending word through the air when other ways of communication are prevented.

The American wild pigeon, or passenger pigeon, existed in this country until about the middle of the last century in countless numbers, but since that time has become, so far as is known, absolutely extinct, only one living specimen being in existence at the present day. Although tens of thousands of these birds were killed annually for many years, some scientific men do not believe that it was exterminated in this way, and its total disappearance has never been satisfactorily accounted for. The male of this species is a beautiful bluish gray over the upper parts



REPRESENTATIVE DOVES.—1. Domestic Turtle-dove. 2. European Wood Pigeon at the left, and Stock-dove at the right. 3. American Wild or Passenger Pigeon. 4. Papuan Crowned Pigeon. 5. Crested and Common Australian Bronze-winged Doves. 6. Blue Rock-dove.

of the body and tail, while the breast is a delicate rosy color, and at the base of the neck is a slight iridescence of a pinkish hue. In the female the breast is pale gray, somewhat lighter than that of the back. There are a few dark spots on the upper feathers of the wings. The eye is blood-red, and the legs also are a bright red color.

In this country it is only somewhat recently that pigeons and their young, known as squabs, have been generally eaten. The older birds are toughened by flight, while squabs are delicious, and are much served in restaurants and hotels. They begin to grow plump at about four weeks old, and are then considered in prime condition for the table. The industry of raising squabs does not require either very large capital or much preparation, beyond the building of proper houses. The natural season for squabs is mid-summer, but they can be raised the year round, and if the business is carried on wisely the birds are prolific enough to make it profitable, each pair of pigeons raising about a dozen young ones a year, under the best conditions.

THE WATER BIRDS.

The same instinct that makes the barnyard fowl able to go in flocks is much more developed in many of the water birds. In the wild state they seem to move about like well trained soldiers, keeping regular order, and yet never getting near enough to interfere. They are like soldiers also in their readiness to act together, and even to help a wounded member of a flock. It is believed that these water birds have become intelligent through the needs of their life, which require them to be ready to meet changes in air, water, or life on land. They also belong to the migratory orders, changing their homes according to the seasons. It is believed that all this shows they might be tamed readily, and yet only the geese and ducks have become

domesticated; though a few other species, like the swan and the grebe, have become half tamed. Unless they are kept from migrating when their season comes, they will not return to their old home.

The varieties of the domestic duck, though they differ widely in form and color, and can be bred with this in view, are all thought to be descended from the wild mallard. From this species come ducks large and small, with color ranging from black to white. A decoy duck is bred abroad to have a noisy voice that will attract the wild ducks for shooting. Although the industry of raising ducks for the market has long been found profitable in some foreign countries, it is only recently that they have been raised here in any considerable numbers, except by farmers who happened to have suitable bodies of water on their farms. Breeders of water fowls are finding out that under careful management it is not even necessary that the birds should have access to any large body of water, as they thrive in confinement and apparently are quite as good eating raised under what seem unnatural conditions. The only difficulty seems to be that the lack of exercise tends to produce fat, rather than the firm meat that is developed from flying and swimming.

The head and neck of the male mallard are a beautiful deep velvety green, highly iridescent. The breast and parts of the wings are a pure, cool gray, and on the upper feathers of the wing is a band of bright, bluish green iridescence. The color scheme of the female is entirely different from that of her mate, the uniform delicate brown color of the feathers being overlaid with a most complicated pattern of stripes and spots, admirably adapted to conceal her from view when sitting on her nest.

THE GEESE.

While we have said that the ordinary chickens do not appear on the records of ancient Egypt, we do



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REPRESENTATIVE DUCKS.—1. Sheldrake. 2. Wild Duck or Mallard. 3. Brahmīnī Duck. 4. Tree Duck. 5. Eider Duck. 6. Wood Duck.

find there the geese, which seem to have been valued as table birds since most ancient times. Despite their long history as tamed birds, they have not been much varied, there being comparatively few varieties. They are quite common throughout the world, especially so in Germany, the Germans eating the flesh fresh, smoked, pickled, and otherwise preserved. The fat of the goose is sometimes eaten as if it were butter, especially by the Jews. The flesh of geese is best when they are not more than three years old, as the meat gradually becomes tough and flavorless. The dainty known as *pâté de foie gras*—that is, “fat-liver paste”—is prepared by confining geese so they can not exercise, and overfeeding them. This produces a fattening of the liver, which is then prepared in various ways and sold as a valued delicacy.

In order to prevent the complete destruction of birds that are eatable, and to save them for the benefit of hunters who seek recreation and exercise in their pursuits, rather than the killing of as many as possible, in all civilized lands laws have been made forbidding the killing of game except at certain seasons. These seasons are so chosen that the parent birds shall have an opportunity to raise their young, and to bring them to a state when they can care for themselves. This prevents the cruelty of shooting parent birds and leaving the young to perish, and it also preserves the species from extinction.

CHAPTER XXIII.

Fishes as Food for Man.

ANIMATE nature contains many strange and wonderful creatures, some fitted as we know for life upon land, some to fly in the air, and others to swim in the waters which form so large a part of the earth's surface. Of these latter, the fishes undoubtedly come first, as being of most use to man in his struggle for existence.

FISH IN ANCIENT TIMES.

As far back as history goes, we find references to the use of fishes as food for man, and many pictures on the sculptured slabs found in Egypt and Assyria show very clearly the methods by which these early races captured and prepared them. The Egyptians employed fish-forms in their picture-writings, as well, and both nations had fish-gods which they worshipped. At the present day some of the Japanese and Chinese also have fish-deities, curious little fat figures holding the sacred "Tai," a brilliant red fish found in eastern seas.

In the Bible, especially in the New Testament, fish are often mentioned in various happenings. Our Saviour figures prominently in several of these incidents, the miraculous draft of fishes, and the feeding of the great multitude with loaves and a few small fishes being pre-eminent as examples. During the Middle Ages also much attention was given to stories regarding certain strange and wonderful creatures which were reputed to be seen on rare occasions by those who sought them. These beings were usually represented as half-man and half-fish, and were sup-

posed to possess supernatural powers. Even at the present day the natives of the East Indies believe in a fish-divinity which has great power over the fishing interests of the communities, and he is also depicted as being part man and part fish.

Belief in the mermaid is another well-known form of this popular fallacy, and even among civilized peoples we find some who actually give credence to this preposterous falsehood. The Chinese very cleverly manufacture these fantastic figures by skilfully combining the dried head and shoulders of a monkey with the tail of a fish. These objects are bought by ignorant sailors from foreign lands, who exhibit them as treasures on their return home, thus keeping up the absurd superstition.

THE FISHING INDUSTRY.

It is very natural, however, that fishes, living as they do in the mysterious depths of the ocean, should have inspired men with a certain vague romance regarding their life and habits. All modern nations, at least those living near large bodies of water, either fresh or salt, devote much time and energy to the problems of catching fish, and for this purpose vast quantities of material are used. Rope and twine are demanded for the nets and lines, steel wires for the hooks, lead for sinkers, cork as floats, etc.; while all sorts of vessels, those propelled by sail and by steam, and only by oars, are employed in the art. Savage tribes are hardly less expert in the capture of fish than their more civilized relations. The Eskimos, Indians, Polynesians, and Negroes, are all great fishermen, and exceedingly skilful in the preparation of tackle for the purpose. In fact, our own methods are simply elaborations of those in use by savage peoples for long ages past.

HOW FISH BREATHE.

In one way or another, all living things must breathe air—mammals, birds, and reptiles having

lungs for this purpose; but the fishes, living as they do beneath the surface of the water, are provided with another organ for extracting the life-giving oxygen from the heavier element in which they live. These lung-like structures are known as gills, and are situated at the junction of the head with the body. To protect these delicate membranes from injury, a hard, bony substance extends downward on either side of the head, encasing the gills, and forming the gill-covers. When a fish breathes, it takes the water into the mouth, and allows it to pass outward through the gills, by which process the oxygen is extracted from the water and taken into the circulation. Most fishes have no true lungs, but some of the more primitive forms are provided with air-bladders, or swimming bladders, and these are used in breathing as well as the gills. These species are usually of a kind inhabiting sluggish streams, or lakes, which have a tendency to dry up in the hot season, and for this reason nature has provided them with a life-preserving organ which is able to obtain some oxygen from the air. When the water becomes too poisonous for the fish to breathe, they come to the surface and gulp in a mouthful of air, which is believed to be taken into the air-bladder, and from there sent through the body by a process resembling our own circulation.

HOW THEY ARE FITTED FOR THEIR LIFE.

A fish, in order to live in its appointed element, must be made to withstand the great pressure exerted by the water, and also be able to float easily and swim with facility. For this reason the body is covered with scales, large or small as the case may be, and provided with fins, which serve to balance the creature. The tail is the powerful swimming organ, and the fin which is attached to it is larger and heavier than the others. As most fish depend for their safety upon speed, they must be able to pass quickly through the water. They are therefore covered with a slimy sub-



AMERICAN FOOD-FISHES.—1. Alewife; 2. Red Snapper; 3. Black Sea-Bass; 4. Steelhead; 5. Spanish Mackerel; 6. Rainbow Trout; 7. Whitefish; 8. Striped Bass; 9. Sunfish; 10. Bluefish; 11. Sanger; 12. Fallfish.

stance which envelopes the entire body and head. If for any reason this delicate film is removed or injured, the animal at once suffers great inconvenience and will actually become water-soaked and drown if the slime is not renewed. We can appreciate the difficulty, therefore, in handling or transporting fish which it is necessary to keep alive, such as those destined for use in an aquarium, or to be sent some distance for re-stocking a pond or stream.

AS FOOD FOR MAN.

In form, as we might suppose, fish differ from any other living creatures, some being smooth and graceful, others coarse and rugged, but all having a characteristic appearance difficult to describe, although easily recognized at a glance. In general, they taper from the head backwards, but some species are most extraordinary in shape and coloration. We shall deal here, however, not so much with the fishes as creatures, but with their use as food for man, a part which they fill most effectually.

Owing to the vastness of the ocean and the multitude of species which it contains, man naturally derives the greater part of his supply from this source; and from time immemorial hardy seamen have risked their lives and fortunes in quest of these scaly creatures of the deep. We have learned by experience that certain kinds are most palatable and best suited to our needs, and fortunately, those which seem to run in the greatest shoals are, as a rule, the best for eating.

THE SALMON.

First among these we may mention the salmon, a large splendid fish which exists in vast quantities on the coast of Alaska and Oregon, and also to a lesser degree in the streams and rivers of Europe. Chief among the Pacific salmons is the chinook, or king salmon, although four or five other species are also used for food. The salmon fisheries on the Pacific

coast are of enormous extent, and yield millions of pounds of fish annually. The salmon are caught, as a rule, in nets stretched across the rivers which in Alaska flow into the Pacific ocean, and the fish either canned or eaten fresh. At certain seasons of the year the salmon approach the coast and ascend the rivers to the breeding places. This is the time when the net-fishermen are busy, and preparations are made to capture as many as possible before the spawning season closes. As usual, these men are not very far-sighted, thinking only of their own immediate gain, and, if allowed to do so, would stretch their nets quite across the rivers, thus capturing most of the salmon ascending the stream. As a result, the supply would soon be reduced to nothing, and then the great industry would have to be abandoned. The United States Government, however, has recently made laws which prohibit the entire closing of the rivers by the nets, and in this way many of the salmon succeed in reaching the spawning grounds, and so the fish are saved from destruction.

It is almost impossible to conceive of the immense numbers of salmon which attempt to reach the spawning grounds at the same time, eye-witnesses telling wonderful tales of the smaller streams being so crowded with struggling fish that they actually force large numbers out of the water, and these fall an easy prey to bears, wildcats, and other animals whose instinct tells them when the harvest has arrived. In fact, the brown bears of Alaska feed almost entirely upon salmon during the summer season, often wading into the stream and scooping out great numbers of the helpless creatures with their powerful paws.

PREPARING SALMON FOR MARKET.

When caught, if they are to be canned, the fish are cleaned and cooked with the greatest celerity, thus ensuring absolute freshness when they are delivered to the consumer. Those which are to be eaten

fresh, however, are not cleaned, but placed on ice, and in this condition sold to the dealers. If it were not for the fact that fish deposit great numbers of eggs, we can see that they might soon become exterminated, even though laws have been made for their protection. The salmon is not by any means at the head of the list in this particular, although a very prolific species. Of course, very few of the young reach maturity, as by far the greater number are eaten or destroyed while they are very small. After having reached a certain age, however, the danger is materially lessened, as they become very swift and powerful swimmers and pretty well able to look out for themselves.

In appearance the salmon is a very handsome creature, and grows to a great size, specimens weighing sixty pounds being not uncommon. During the breeding season the male develops a curious growth of the upper jaw, which then assumes somewhat the form of a beak, and curves in a sharp hook over the mouth. This beak gives the fish a most singular appearance, and adds greatly to its ferocious expression. The body of the salmon is covered with rather fine scales, which are silvery in appearance, becoming somewhat bluish in color on the back, while the flesh is a deep red, and very rich and oily.

ANGLING FOR SALMON.

When the salmon are taken in nets, the gamey qualities are naturally lost sight of, and it is only when caught with a hook and line that one realizes the splendid nerve and power of the creature in its struggles for freedom. Angling for salmon has long been a favorite sport for devotees of the rod, and is perhaps the finest thing in that sport that one can experience. In Scotland, certain streams and rivers are rigidly protected by law, and only those having the privilege to fish therein are allowed to enjoy this most fascinating pastime. A rather light rod and tackle

are used, as otherwise the game would not have fair play. The favorite haunts of the wary creatures are certain deep holes which abound in the rocky streams where it loves to dwell, and these holes are known to the experienced angler, who cautiously approaches and drops a tempting bait in the shape of an artificial fly into the clear, swift water. The fly is not weighted, but floats lightly upon the surface of the stream, luring the hungry fish from its hiding place beneath some overhanging rock.

There is a tremendous splash as the salmon leaps for and seizes the glittering fly, and then begins a struggle which tests the nerve of the most experienced angler. Sometimes the "quarry," as the hooked fish is called, goes straight to the bottom and there sulks, until suddenly with a fierce rush, it dashes madly upwards, making the reel sing as it goes, and, leaping several feet into the air, shakes its head from side to side, in order to throw out the offending hook. At other times it rushes wildly about through the swift current, over boulders and through rapids, where the angler is obliged to follow at the imminent risk of a ducking in the icy water, to say the least; and where often a single moment of unwariness on the angler's part gives the gallant fighter a chance to cut the line against some sharp rock, or else to disgorge the hook by a series of quick, fierce bounds from its native element.

More often, however, the skill of the man prevails over that of the fish, and the glittering shape is drawn slowly to a shallow spot at the edge of the rapid, where an assistant stands ready with a "gaff"—a pole having a sharp hook in its end—which he deftly inserts into the gills of the luckless creature, and the struggle is over.

THE BROOK TROUT.

The salmon seem to merge into the various fishes which we know as trout very gradually, and through

many species. The American brook trout is not a true *trout*, scientifically speaking, but a species of *charr*, a form fairly common in the streams of Europe. Everybody knows, or should know, the brook trout, that lovely inhabitant of mountain streams about which so much delightful literature has been written.

Few fish surpass the trout for excellence of flesh, and fewer still for beauty of appearance. The body is smooth, appearing quite without scales, although they are present in minute form. Over its surface are scattered tiny spots of red, blue, and yellow, while the lower fins are a lovely crimson, edged with creamy white. The trout is a powerful fighter when hooked, quite as much so as its larger relative the salmon, and leaps and darts about in the most astonishing manner when the angler has been fortunate enough to get one on his line. The breeding of trout is carried on in many different States, at present, and has been of immense value in helping restock depleted lakes and streams. The young, when newly hatched, are tiny things, but with care and good food they grow rapidly. Cold, pure, running water is a necessity for their proper development, and, given that requisite, they do very well.

THE BLACK BASS.

Although possibly the general opinion would be to place the salmon and trout at the head of the list of game-fishes in fresh water, many anglers prefer the black bass, that fierce and wary creature which is found in many of our eastern lakes and streams. In appearance the species differs widely from those just mentioned, having a much larger head and mouth than either, while the body is covered with hard, coarse scales of a dark greenish hue. The black bass is a handsome creature, nevertheless, giving one an impression of strength and agility which are well merited by his action when hooked. Only those who have expe-

rienced the powerful rushes made by this Titan in its struggles to escape can realize the game qualities which render it so popular among a host of admirers.

The black bass is not so large as the salmon, full grown specimens seldom weighing more than six pounds, while the average is probably not more than half a pound in weight. It more than makes up for this, however, by its courage and ferocity; and the man who hooks a five-pound black bass on a light rod will think he is about to bring in a shark.

When hooked, the bass has many tricks at its command, and will turn and double about in the most surprising manner. Its favorite trick, when one is fishing from a boat that is moored with an anchor, is to wind the line about the anchor rope, thereby breaking it off short and effecting its own release. Another dodge is to rush directly under the boat, bending the rod so short in the angler's hand that, unless the make is of the best quality, something has to go. It also, like the salmon, will jump from the water if it has the least slack line, and will nearly always escape if allowed to do this, as the mouth is very hard inside, and unless the hook is swallowed, it will most surely be thrown out. Bass are extremely capricious, as to the bait which they will take, and to have luck in fishing for them one must endeavor to find out just what bait is used in any particular locality.

THE MUSCALLONGE.

While undoubtedly the black bass holds precedence as a game-fish, considering its size and weight, other larger and more ponderous species claim a larger share of the angler's attention. In fresh water, the muscallonge, an enormous pike, weighing as much as eighty or a hundred pounds, holds first place; while in the sea many great fishes of different species test all the science, strength and skill that the angler possesses. It is a rather curious fact, however, that with

the exception of the salmon, few of the larger game-fishes are much used as food, not only because their numbers are less, but because the flesh is not really as good for eating as that of many of the smaller and more abundant varieties.

Undoubtedly, the favorite fresh-water form is the whitefish of our Great Lakes, a beautiful silvery fellow, averaging perhaps a foot in length and having delicious white, oily flesh. The whitefish, although it does not appear so to a casual observer, is quite nearly related to the salmon, while the flesh is more delicate and of finer flavor. It does not take a hook, but is caught in large numbers in nets, somewhat after the manner of herrings.

THE SPOONBILL STURGEON.

While dealing with fresh-water fishes, it will be well to mention the more important food forms found in the United States. Next in importance to the whitefish very probably comes the polyodon, or spoon-billed sturgeon, which inhabits the southern lakes and rivers of the United States. This grotesque monster grows to a large size, specimens weighing fifty pounds being not uncommon. The strange bill of the snout is lengthened greatly and spread out into a paddle-like form, the precise use of which is not certainly known. It is supposed by some observers to be of service in stirring up the mud in the search for small crustaceans to serve as food, but there is some doubt about this explanation. The roe of the spoonbill is the part most used as food, it being prepared as is the Russian caviar, by a process of washing and salting. The flesh also is smoked, and sold as actual sturgeon, the deception being a harmless one, as the fish is really a sturgeon in species, although not the one known to commerce.

Great numbers of these strange creatures are caught at a single haul of the great net or seine, which

is used as a means of securing them, the process being quite a complicated one. The boats which convey the seine are large flat-bottomed affairs, and are provided with a huge reel at the stern on which the net is wound when not in use, and from which it is unwound when it is being paid out in the operation of fishing. A number of men are engaged in the business, which is a fairly profitable one.

THE CATFISH.

The rest of the fresh-water species which are used as food in the United States are of comparatively little importance to any but local markets. Chief among these, however, we may cite the bullhead, or catfish, a dark, slimy creature armed with sharp side and back fins, which every boy has caught in the lakes or rivers near his home. Bullheads bite best at night; and this, as well as the fact that they pull quite strongly and make a great fuss when being drawn out of the water, makes them a prime favorite with the youthful fishermen. Many people believe that the soft feelers, or "whiskers," about the mouth are capable of inflicting wounds, but this is not so; the real offensive weapons are the first back fin and the two side fins, or pectorals, just behind the gills. With these the bullhead is able to inflict a really painful wound, rendered doubly so by the fact that the slime which always adheres to the spines seems often to poison the flesh in entering. Experienced fishermen know just how to grasp the squirming, slippery bullheads to avoid these spines, but the unwary youth who seizes one for the first time is apt to be badly cut in several places. Catfish have no scales, but are covered with a smooth slimy skin like that of an eel, and this skin is usually taken off before the fish is cooked. They are delicious eating, in spite of their mud-loving habits; and are justly esteemed by many people. Pickerel, yellow perch and white perch, and two or three species of bass, about

complete the list of our more generally used fresh-water food fish, but of course some local anglers will eat almost anything which comes their way.

THE CARP.

In Europe there are several other species which figure rather largely in food consumption, the first of these being the carp, a fish which loves to dwell in rather muddy water and will thrive in streams and ponds too polluted for most other species to live in. The carp is very destructive to other species, as it feeds largely on their eggs during the hatching season. It has proved a great detriment to the food fishes of America, where it has, unfortunately, been introduced. The tench, another mud-loving form, is also esteemed in Europe, though it is difficult to see why it is so popular, as its flesh is somewhat muddy in flavor.

THE STURGEON.

A far more important fish of Europe is the sturgeon, the roe of which is used in making the celebrated caviar. The flesh is also smoked, and sold in large quantities. Sturgeon are found in many of the larger Russian rivers, and also in the Danube. They grow to an enormous size, sometimes attaining a length of twenty-four feet and a weight of fifteen hundred pounds. The fish are caught in seines, or gill-nets, and are very powerful, lashing about in terrific fashion when drawn to the surface. They do not take the hook, having a very curious sucker-like mouth, placed on the under side of the head, enabling them to feed on small crustaceans which they find in the sand.

In form, the sturgeon is unique among fishes, being covered along the sides with large bony plates which form a defensive armor, and one of undoubted use to the fish in protecting it from enemies. The sturgeons are rather closely related to the sharks and have the same shaped tail—not found in other fishes—the

upper lobe being much longer than the lower. A similar species is also found in the rivers and lakes of the United States. The spoonbill sturgeon, already referred to, is also included in the family which is, in certain ways, one of the most important of all the edible varieties.

THE HERRING.

While the various species already mentioned are of great service to man, they are really of secondary importance to those which we shall now describe, namely, the herring family. This comprises, first of all, the true herring (which is the principal species used for food) the sardines, anchovies, menhaden, shad, etc. They all are fishes of moderate size, the shad, which is the largest, averaging perhaps a foot in length, while the herring is somewhat smaller, and the sardines quite diminutive. All the species are covered with glittering silvery scales, highly iridescent, and very easily scraped off. They all feed on minute particles of food which they obtain by coming close to the surface of the water, with the jaws widely distended. Vast numbers of herrings exist in the sea off the coast of Europe and the British Isles, and from time immemorial their capture has been a source of employment for thousands of men who risk their lives in this precarious calling. They are often overtaken by storms and fogs, a source of great danger to these hardy seafarers, as they are exposed in small boats to the fury of the elements.

The principal herring-fishery is in the North Sea, or German ocean, that large shallow body of water which skirts the British Isles on the east and the shores of France and Germany on the north. For this fishery large, clumsy boats called "luggers" are used, sails being the propelling power. Each vessel carries a crew of several men and has besides a number of small boats which are used to gather up the

immensely large seines employed in the herring fishery. As a rule, the fish approach the shore in great numbers during the spawning months, and a watch is kept for them by the fishermen who are able to locate the schools of herring by the great numbers of gulls and other sea-birds which hover over and prey upon them, and also by the broken appearance of the water, caused by countless thousands of the fish in swimming just below the surface.

As soon as these welcome signs are visible, the men put to sea in the luggers and endeavor to round up as many fish as possible by encircling them in the meshes of the seine. This is paid out from the stern of the lugger, and then the crew, embarking in their small boats, row along the edges of the great circle about the struggling mass of fishes, which is gradually forced nearer and nearer the lugger by the combined efforts of the crew. When as many herring as possible are surrounded, the men gradually force up the bottom of the seine by raising it into the small boats, and the myriads of glistening creatures are raised from the water and thrown into the hold of the lugger, which has by this time approached as closely as possible to the scene of operations. Hundreds of thousands of the fish are caught at a single haul, and the total of the season's catch runs into the millions.

Several countries participate in this herring fishery, chief among them being England, France, Germany, and Sweden and Norway. The men are a fine sturdy lot, and indeed they have to be, as they suffer great privations and are inured to every form of hardship. Whole families of men, grandfathers, sons, and grandchildren, engage in this arduous work for days at a time, and the women at home watch and wait with the keenest anxiety for the return of their husbands and brothers from the fishing grounds. Only too often their worst fears are realized, and they learn that their dear ones are never to return. The

North Sea is noted for the terrific gales which annually sweep across the wide expanse, tearing the fishing boats from their moorings and dashing them upon the pitiless shores to be ground to pieces in the terrible surf. In spite of all these dangers, men are always found anxious and willing to risk their lives, and it speaks well for the manhood of the race that it should be so.

OTHER METHODS IN HERRING FISHING.

Besides the method just described, there are several others in vogue, viz., by the use of weirs, gill-nets, and a rather more primitive mode of fishing in which the men engaged go out at night with a great lighted torch in the bow of the boat. The brilliant illumination attracts the herrings, which rise to the surface of the water and are then scooped up by the men with dip-nets. It is estimated that the total catch in Europe and the British Isles is about four billions annually. The celebrated whitebait served in London as a particularly dainty dish are simply the young of the herring which are captured in nets at the mouth of the Thames. Great quantities of herring are eaten fresh, but by far the larger part of the catch is preserved in various ways. They are either smoked or salted, packed in small barrels or boxes, and shipped to all parts of the world. The famous Yarmouth bloaters sold in England are herrings which have been smoked but not salted, so that they are rather difficult to transport, since they will not keep for any length of time. The kippered herring of Scotland is also another way of preparing them, and by many people is thought to be the most appetizing form of curing these savory fish. Of late years the sale of kippered herring packed in tin has increased greatly in this country, the product coming from Scotland and Norway. By far the largest part of the catch, however, is preserved in brine, the fish being split open, cleaned,

and placed in small casks or barrels. In this condition they keep for a long time, but lack the delicate flavor of those prepared in the manner previously described.

SARDINES, OR PILCHARD.

Another form of herring justly celebrated as an article of food is the sardine, or pilchard. This species is considerably smaller than the true herring, and is usually eaten in the cured state only. The fish approach the shore during the spawning season, and their coming is eagerly looked for by the fisher-folk along the coast of Cornwall, in England, where much of this fishing is done. A man called a huer, or crier, is stationed on some high point along the coast, and keeps a sharp lookout for the expected schools of sardines. As soon as his practised eye descries a shoal of these much-persecuted little fish, he gives a signal to the crew of a large boat which is waiting close at hand, and the crew immediately set out to surround them. This is done by means of an immense seine some six hundred yards in length and seventy-two feet deep. The boat's crew lower the seine so that it falls between the fish and the open sea, while a second boat puts out from the shore with another seine which then draws slowly towards the first one, thus trapping the struggling fish between two vertical walls of netting.

As the boats approach each other, a most exciting scene ensues, the glittering creatures dashing hither and thither, while the women and children on the shore shout encouragement to the men in the boats. As the catch is drawn to the shore, the entire population of the neighborhood hurry down to lend a hand in securing the finny quarry.

Some of the fish are salted and packed in small barrels, but the greater number are dressed, soaked in brine for an hour, and then washed in clean water.

They are then dried by being placed on screens, after which they are cooked in boiling oil, drained again, and passed on to the canners who place them in small tin boxes, secure them, and make them ready for shipment, about a hundred boxes being placed in a case. It is as canned fish that we usually see them, and the number consumed is very large. The so-called "sardines" put up in the United States are simply young herrings, and lack the delicate flavor of the foreign product.

THE SHAD.

The largest species of herring used for food is the shad, a fish which was at one time very common in most of our eastern tidal rivers, but has grown rather scarce of late years. Although not found originally on the Pacific coast, it has been introduced there very successfully. The shad appear first in Florida, about November, and reach the Potomac river some time in April. In June they are caught in the Hudson and other nearby rivers, but not in such profusion as formerly. The flesh of the shad is rich and well flavored, but is filled with a great number of small bones which it is almost impossible to separate from the surrounding tissue. The roe is considered a great delicacy, and is usually cooked separately from the fish.

Planked shad is the result of a favorite method of cooking this delicious fish, as it imparts a fine flavor to the flesh. The fish is cleaned, split open, and fastened to a plank. It is then placed in front of a fire and broiled until done. If properly handled in cooking and served whole, most of the small bones are easily removed with the backbone, but if the flesh is cut up, as is sometimes done, the tiny hair-like bones become so mixed up with the flesh as to make it almost uneatable.

Shad fry are hatched artificially by the United States Government Fish Commission, which uses a

special boat for the purpose, the steamer *Fish Hawk*. As the fry are hatched, they are set free in the Potomac and other large streams, and these additions have really kept up the stock which was in great danger of extermination.

GOVERNMENT FISH-HATCHING STATIONS.

Just here it may be well to mention the fact that the United States Government maintains at great expense several fish-hatching stations at different points. One of the largest and oldest of these is at Woods Hole, a small village situated on the mainland of Massachusetts, just opposite Martha's Vineyard. At this station the principal fish hatched are the cod and flounder, several millions of these valuable food-fishes being distributed each year from this point. There are various large hatcheries for salmon and trout in suitable localities throughout the country, and it has been found by practical experience that these hatcheries are of very great service in keeping up the general supply. Experiments are also made by special men to determine the food value of other fishes not commonly eaten. Dog-fish have been used in this way, and the flesh has been found palatable and nutritious; but there seems to be a certain prejudice in this country against the eating of sharks, although the Italian colonies consume all they can procure. We no doubt foolishly limit ourselves in the matter of food fishes by these common superstitions, and it is for this very purpose that the Government strives to overcome the popular aversion to certain really edible species.

TARPON.

Before leaving the herrings we must not fail to call attention to the tarpon, a near relative, and the largest of the family. This great fish grows to a length of six or seven feet, and a weight of over a hundred pounds. The scales of the tarpon are very

large, and have given the fish its common French name, *grande écaillé*. It has an enormous mouth, which is widely distended as the fish hurls itself out of the water, after being hooked. Tarpon are little used as food, but are fished for by anglers in search of sport. The tackle used is a rather light rod, and many hundred feet of strong line upon a huge reel. The bait is a fish, usually a mullet, which is allowed to swim about to attract the tarpon. The fisherman stands or sits in a small boat, which is rowed by one man who is an expert at the game. Most of the fishing is done along the southern and western coast of Florida, and in comparatively shallow water. The shock of a big tarpon is terrific, and the strain on the hook very great unless the angler be a man of long experience. In any case the battle is a furious one, and sometimes lasts for several hours. The giant fish leaps into the air to a height of six feet or more, shaking itself from side to side in a frantic effort to rid itself of the offending hook. Many photographs have been taken of the tarpon during these great leaps which clearly show the extraordinary conformation of the fish's mouth and the powerful contortions of the body. In form the tarpon is very much like a gigantic herring, but the second back fin has a long streamer at the end nearest the tail.

THE COD.

Of all fishes, the cod stands pre-eminent as man's greatest source of food supply, hundreds of thousands of the great fish being caught annually off the Grand Banks of Newfoundland and about the shores of Iceland and Norway. Great fleets of boats are engaged in the fishing, which is attended with greater difficulties and hardships than all others combined. Owing to the fact that the cod is caught only in northern oceans, and also is found in deep water, its capture is always a source of more or less danger from storms

and fogs, but when the rigors of a northern climate in the shape of ice and snow are added to these, the industry becomes truly hazardous.

The greater part of this fishing is now done along the Labrador coast and the reefs of Newfoundland. Much of it is carried on in winter, when the temperature is far below the freezing-point and the air is filled with snow and sleet. The terrible hardships of the men engaged in this fishery have become better known of late years, and truly harrowing tales of privation and suffering are of common occurrence. The vessels used on this side of the Atlantic are splendidly built schooners, usually with two masts, and carrying a number of men in the crew. Several boats called dories, are piled up one within another, forming so-called "nests" on the deck of the schooner, to be launched when the fishing-banks are reached.

Some of the men go off in these small boats, while others remain to work the larger vessel and to fish from her deck. Hand lines, or trawls, are used, baited with clams or bits of fish. The cod is a deep water fish, swimming close to the bottom, so that the lines used are very long ones. There is very little sport attached to the fishing, as when hooked the cod comes up like a log, without any struggle.

Many of the fish, those which are sold fresh, are kept alive by being placed in wells aboard the schooner, but the others are split open, cleaned, and placed in salt in tubs in the vessel's hold. The livers, from which the valuable oil is obtained, are placed carefully by themselves in separate receptacles, and the oil is expressed later. The flesh of the cod is rather tasteless, but is firm, and keeps very well in salt—a most useful property. It is a large fish, specimens sometimes weighing eighty pounds, but the average is perhaps fifteen to twenty.

In form it is unlike any of the fishes yet mentioned, being a large, rather smooth fish in appearance, with

a large head, and a tail cut off squarely at the end, not divided into two lobes as in most fishes. There are also three dorsal or back fins, instead of two, and a small barbel, or feeler, hangs from the chin. Other closely allied species also used as food are the haddock (known to the Scotch as "Finnan haddie"), the pollock, hake, etc. The number of eggs laid by the cod is enormous, a single specimen of seventy pounds in weight laying nine million eggs in a season.

The cod fishing, like that of the herring, has existed for centuries, and was known to the ancients. The fishing boats from France actually come across the Atlantic to fish in the Grand Banks of Newfoundland, while along the North Atlantic coast of the United States the principal industry is the preparation of the cod for market. Boston and Gloucester are the largest markets for the sale of the fish, which are then distributed to all the ports of the world. Boiling seems to be the principal method of cooking the fresh fish, although fried cod-steaks are very palatable. The odor when cooking is very disagreeable, although the raw fish has very little smell. Salt cod is used in a great number of ways. The fish is either freshened by being soaked in water, or else is shredded and made into fishballs or cakes, an excellent way of preparing it. Smoked haddock is eaten largely by the poorer classes in the British Isles, but is here considered somewhat of a dainty. In this condition it is hard to digest, but is very tasty.

THE FLAT FISH.

Besides the various kinds already mentioned there remains one other class which are largely used as food, namely, the so-called flat-fishes. The largest of these, and the most important, is the halibut, a huge fish sometimes weighing several hundred pounds, which is caught somewhat after the manner of the cod, and in the same locality. The halibut is considered by

many people to be very delicious eating, and the flesh always brings a good price in the market. It is firm, white, and somewhat richer than cod, to which it bears some resemblance. It is usually cut into steaks and fried. The young of the fish are called "chicken" halibut, and are thought to be particularly good. Halibut are also caught on the coast of Alaska by the natives of that region, as well as in the colder seas around Greenland and the north of Europe. In proportion, the halibut is a deeper fish than the flounder, and is said to swim more nearly upright in the water.

THE FLOUNDER.

The common flounder or fluke, is one of the best known food fishes, and by many is preferred to all others. It is the prize of many local anglers who can not afford to spend the time to go far afield in search of sport, as well as a commercially valuable fish on account of its abundance. Flounders are pre-eminently bottom-of-the-sea-fish, fitted by nature to live buried in the sand or mud, with only the eyes and mouth sticking out. They are voracious feeders, biting at almost anything that comes within reach, but preferring a live minnow to other bait. They are often caught in set nets, as well, into which they go in search of food. There are several species along the coasts, notably the winter flounder, the summer flounder, "window-pane," and hog-choker. The two latter are not used as food, being too thin and bony to be available. In Europe the chief forms are the sole, plaice, and turbot. The former is a great delicacy, filleted sole being the finest dish of its kind and relished by epicures the world over. The turbot is also excellent eating, and is much prized in England.

MACKERELS AND BLUEFISH.

The mackerel is another of the highly prized fishes sought for by man, and great numbers of these beau-

tiful fish are taken annually, most of them being caught on hand-lines. The northern form is the common mackerel, a fish abundant at certain seasons on the Atlantic coasts where it swims in great schools close to the surface of the water. It is one of the swiftest fish known, the long, tapering, smooth body cutting the water at lightning speed. The creature is most beautiful in color, being a brilliant steely blue on the back, the sides covered with a glorious iridescence of silver and rose, while bands of greenish blue run across the back and half way down the glittering body. The belly is pure silver of the highest sheen, and the eye is a brilliant golden yellow. To assist the fish in its swift evolutions the last third of the body is provided above and below with tiny finlets, which are reversible, and which are used as rudders in conjunction with the powerful tail. The first fin of the back sets in a kind of groove, so that it offers very little resistance to the water. All these points combine to make the mackerel perhaps the speediest fish that swims the seas, a veritable greyhound of the ocean, and one which destroys its prey of small fish with relentless energy.

Mackerel are delicious eating for those who like them, being rich and rather strong in flavor, but having a slightly acid taste which to some is not palatable. They are best broiled, and must be eaten before they turn soft, which is sure to be the case if they are kept long after being taken out of the water. By far the greater number caught, however, are salted and sold in small barrels. Some people are very fond of them in this way, served as a relish, but the strong brine seems to some to destroy the flavor of the fresh fish. The Spanish mackerel, a southern cousin of the former, ranks as perhaps the finest food fish on this side of the Atlantic. It is always eaten fresh, it being considered by epicures a sacrilege to serve it in any other way.

THE BONITO AND TUNNY.

Besides these smaller species there are several larger forms, notably the bonito, or king fish of Florida, and, last, but not least by any means, the great tunny or tuna, a gigantic fish sometimes weighing fifteen hundred pounds, which is found in all warm and temperate seas. This great mackerel has dark red meat, much like beef in appearance, and is esteemed greatly by the people living along the shores of the Mediterranean Sea, where it is caught in large numbers. It was known to the early Greeks and Romans, and used by them also as food.

In appearance the tunny is like a huge mackerel, but is deeper and rounder in the body. It has the same smooth form, however, and is a very active and powerful fish. In California it is known as the tuna, and is a favorite object of sport with anglers who fish for it with a rod and comparatively light tackle. When hooked, it develops enormous strength, sometimes towing the boat for hours before it succumbs.

THE SWORDFISH.

Another great fish having commercial importance is the swordfish, perhaps the largest true fish, with the exception of the sharks and related forms, found in the ocean. This giant creature was also for a long time somewhat of a mystery to naturalists, as its young was unknown, but of late years they have been discovered in the Mediterranean Sea. In form, however, they are so unlike the adult that their true relationship was not at first recognized. The mature fish is not unlike a mackerel in general shape, having a huge crescent-shaped tail and an enormous upright dorsal fin. The strangest thing about the creature is the great sword or snout which projects for five feet in front of the eyes and is a terrible weapon of offense. The precise use of this formidable armature is not known, but it is supposed to be of service to the fish

in securing its food. Seafaring men say that the swordfish swims into a school of smaller fish thrashing right and left with the sword-like snout, thereby maiming and wounding many of the unfortunate little creatures which then fall an easy prey. Be that as it may, the swordfish, whether by accident or design, can give a good account of itself when attacked by man, and many thrilling tales are told by fishermen whose boats have been pierced by the excited fish in its struggles for freedom.

The swordfish is not taken with a hook, but is harpooned, usually from the deck or bowsprit of a small sloop which steals upon the unwary creatures while they are floating on the surface of the water. A sort of platform is often built out over the bow of the boat, and there the harpooner takes his stand, while a second man climbs to the top of the mast to look out for the finny prey. When one is sighted, the boat is sailed close to the great creature, and, if possible, the harpoon is hurled into its side. Then begins a truly royal contest, as the fish is possessed of great power, towing the boat about, and often breaking away from the harpoon altogether.

The flesh of the swordfish is hard and close in texture, not unlike veal, and is very rich and oily. It is considered a delicacy in the New England States, but is seldom seen near New York City.

SOME FISH OF LESS IMPORTANCE.

The fish mentioned comprise the principal species used for food by man, but we may cite a few others to complete the list. The curious fish known as eels are eaten in about all countries where they are procurable, although some people have an aversion to them because of their supposed snake-like affinities. This prejudice is quite unfounded, however, as the eel is a true fish, quite removed from any reptile in structure. The skate, a creature closely related to the shark, is

also eaten in Europe, but does not sell well in America. The fins only are used, the rest being hard and tough. There are no bones, the skate having a cartilaginous skeleton.

While not all the species used as food by man are included in this necessarily brief account, enough have been mentioned to show the vast importance of the fish as a diet for human beings, and also to point out that the capture of these scaled and aquatic creatures requires in many instances the greatest fortitude, resources, and skill, thereby developing a class of men famed for these qualities since the dawn of history.

CHAPTER XXIV.

Reptiles as Food for Man.

A SCIENTIST judges the character of an animal's food by the shape of its teeth, and finds it convenient to designate the various groups in this way. Thus we speak of carnivorous animals, meaning those which eat flesh; herbivorous animals, those feeding on vegetation; and omnivorous creatures, the class which eats all sorts of food, both flesh and vegetable. Man belongs to this latter class, and his diet comprises a very great number of edible products. Mammals, birds, and fish, are equally acceptable to him when pressed by hunger; nor does he stop here, but continues through the entire list of animate creatures, the reptiles, insects, crustaceans, shell-fish, and even some of the lowlier types being eaten in some form or another.

Civilized man rather draws the line at reptiles, but lizards and snakes are devoured by savage races, the former (especially the iguana, found in South America and Mexico) being considered a great delicacy. In Africa the natives eat the larger pythons, or rock-snakes, as well, and are not averse to crocodiles when they can be secured. Indeed, while such food is repulsive to us, there is nothing really harmful in it, the flesh of a freshly-killed alligator being very white and appetizing in appearance. Most reptiles feed only upon living food which they kill themselves, and are usually in a perfectly healthy condition.

Frogs have always been used as food, and even civilized people regard frogs' legs as a much prized dainty. In the United States the bullfrog is the species most eagerly sought for, principally on account



IGUANAS.—1. Ring-Tailed Iguana. 2. Helmetted Basilisk. 3. Galapagos Land Lizard. 4. California Horned Toad. 5. Galapagos Sea Lizard. 6. American Fence Lizard.

of its large size. The long and powerful hind legs are the only part that is eaten, the rest of the creature being discarded. These are regarded as luxuries and always bring a high price in the market.

The turtle family has long furnished food for man, the ancients being well aware of the nutritious quality of the flesh, while turtle eggs are still eaten by many wild tribes, and at one time, before the days of canned foods, were often the means of saving whole ships' crews from the dreaded disease known as scurvy. The green turtle is the species best known to commerce, but many other kinds are eaten, the loggerheads of the Florida coast being almost as great a favorite. The meat of the turtle is white and well flavored, and the greenish fat enters as a constituent into the far-famed dainty known as turtle-soup.

The catching of sea-turtles is a unique performance, and is based upon a study of the habits of the reptile in question. The female turtle, when she wishes to deposit her eggs, crawls out of her ocean home onto the warm and sandy beaches which line the shores of the southern seas, and there digs with her flippers a deep hole in the sand, just above high-water mark. In this she lays some fifty or sixty eggs, enclosed in a leathery skin, and then covers them carefully with sand. This operation over, she returns to her native element, unless intercepted in her journey by some wild animal, or, more often still, by a party of two-legged turtle hunters, who rush upon the almost defenceless creature and endeavor to turn her over on her back, in which condition she is perfectly helpless. In this sorry state the poor animal is placed upon the deck of some north-bound vessel, and brought to the markets to be later used as food.

The Galapagos Islands, off the coast of Chile, at one time furnished many a meal for half-famished sailors who landed there with the express purpose of securing the giant tortoises which formerly were very

abundant. Of late years, however, owing to the continual persecution, this huge species has become almost exterminated, and specimens are with difficulty secured for zoölogical collections. The great tortoises were land-living forms, feeding upon the vegetation found upon the islands. They sometimes reached an enormous size, individuals weighing two hundred and fifty pounds being not uncommon. This weight, however, is often exceeded by that of the huge sea-turtles already mentioned, which tip the scales not infrequently at six hundred pounds or more. Indeed, one enormous species, the luth, or leather-backed turtle, attains a weight of one thousand pounds.

Among the smaller species in this country the one most highly prized is the diamond-backed terrapin, a variety inhabiting our southern bays and estuaries. Among Southerners, particularly, terrapin is thought to be the acme of all that is excellent, and so great is the demand for them that they bring very large sums in the markets, seventy-five dollars a dozen being a standard price the year round. At present, a number of terrapin farms are in operation, although it takes about ten years for the animals to reach an edible size. The Japanese have, for years, studied the problem of turtle-farming, and have brought the industry to a high state of perfection.

In the United States there is one other well-known species which is used as food, namely, the snapping-turtle, a very fierce and gruesome creature which inhabits many of our streams and ponds. This formidable brute grows to a large size, thirty pounds or more in weight, and has a very long and powerful neck, which it extends with great quickness when it wishes to seize its prey. The horny jaws can inflict a very severe bite, as the animal grasps an offending object with the ferocity of a bulldog. It is very tenacious of life, the jaws remaining locked long after the head has been severed from the body.

LOBSTERS, CRABS, ETC.

Among these hard-shelled creatures, the lobsters reign supreme as a favorite article of food. Formerly some of these shellfish grew to an enormous size, but a relentless war of extermination is carried on from year to year, so that the specimens are now much smaller, and the species is really in danger of extinction. The United States Government, realizing the fact, has endeavored to raise the young lobsters artificially, but has encountered no end of difficulties in the operation. Recently, however, with this end in view, some fairly successful experiments have been made, and it is to be hoped that the results will be more satisfactory as time goes on. The lobster fishermen are responsible for much of the scarcity of these toothsome creatures, as they will return to the water neither the young, nor the females with eggs which are found in the traps, but dispose of their entire catch in one way or another. The Government has passed a law prohibiting the sale of "short lobsters"—that is, those under eight inches in length—but, as usual, the very people that the law aims to benefit are the worst offenders against it.

In European countries, the smaller, lobster-like forms known as shrimps and prawns are extensively eaten, being boiled and sold in large quantities in London and many continental cities.

The blue, or edible, crab also forms a frequent article of diet in the United States. Vast numbers of crabs are sold in the markets, some in the soft-shelled state, but by far the larger number with the shell completely formed.

On the Continent of Europe, large numbers of sea crayfish are taken, as well as the fresh-water species. The latter, although common in America, are seldom used for food.

SNAILS.

The curious and interesting group of creatures which we call snails have been used as food for many

centuries. The Romans were particularly partial to them, and maintained special establishments where they were regularly raised and fattened for the table. Under favorable conditions, the snail grows to an enormous size, and even at the present day the French people regard them as a very delectable relish. Any one, however, who has not been used to them as an article of food finds it a rather difficult matter to eat one of these strange-looking objects.

There are also a large number of marine snails which are eaten in various parts of the world. In England, the small snail known as the periwinkle is boiled and eaten. Some fifty years ago, large numbers of them were consumed, but the custom seems to have declined somewhat in recent years. The larger sea-snails, or conchs, which are common in all warm seas, are devoured with avidity by the South Sea Islanders. The flesh, while wholesome, is tough and somewhat tasteless; but few things come amiss to the hungry savage who may have been on short rations for some days, and who welcomes with joy any addition to his rather scanty bill of fare.

OYSTERS, CLAMS, ETC.

The shell-fish were, no doubt, sought after by man in very early times, especially by those tribes living near the sea. The abundance of these lowly creatures and the ease with which they could be procured, contributed greatly to their popularity as food. All along the southern coasts of the United States huge piles of oyster- and clam-shells are found, mute witnesses of the vast numbers which were consumed by the former inhabitants of this country. These deposits, known as "kitchen middens," often contain relics of bygone days in the shape of implements and pottery.

One can hardly conceive of the abundance of shell-fish, principally clams and oysters, which existed in our streams and along our shores in the earlier days, and even now, after the lapse of centuries, millions of

the delicious bivalves are annually consumed. Chief among them is the oyster, which is found in great numbers on both sides of the Atlantic Ocean, and, in fact, on nearly all rocky coasts. This delicious shell-fish is at its best in the colder weather, but, if perfectly fresh, may be eaten with impunity at all times of the year. The danger lies in the fact that very few oysters are sold which have not been "pumped" by being placed in fresh water for several days before shipment. When this water is impure, the oyster naturally imbibes numbers of poisonous germs, which, when taken into the system, may give rise to serious disorders, chief among them being typhoid fever.

Clams also form a considerable article of diet among many nations. In the United States there are two edible kinds, known, respectively, as hard- and soft-shelled clams, the former having a thick, hard shell, and the latter a very thin and delicate covering. Hard clams are usually eaten either raw or made into a kind of stew or "chowder," while the soft clams are either steamed or fried.

On the Pacific coast, the abalone clam, a large mollusk, the lining of whose shell is much used as mother-of-pearl, is taken by the Chinese and Portuguese fishermen, who constitute a considerable proportion of the population of California and other Western States.

In Europe, the mussel is much eaten by the poorer classes living along the sea-coasts, but in the United States, although this bivalve exists in large numbers, there is some prejudice against its use as food.

The scallop, another form of shell-fish, is relished by many, but only the large muscle holding the shells together is eaten, the actual body of the creature being so thin and watery that it is discarded. The fact that this is simply a lump of pure meat often puzzles those who imagine that they are eating the entire body of the animal, as is the case with clams and oysters.

INSECTS.

One would hardly suppose that insects would form an article of diet among human beings, yet such is the case. We recall the locusts of Biblical fame, which even now are eaten in Eastern countries generally. Some African savages eat caterpillars, and white ants are considered a relish by the same peoples. Some ants fill themselves with honey, and thus filled are considered a delicacy by certain savages.

SEA-URCHINS.

In Italy, the eggs of the sea-urchin form a portion of the sea-food consumed by the inhabitants of cities bordering the Mediterranean. They are said to resemble shad-roë in general appearance and flavor, and are taken from the prickly little creatures just before the spawning season.

HOLOTHURIANS.

[The same people also make use of this larger species, which they call the trepang. The animal is split open and dried, and in this condition sold to the poorer classes among the natives, who make from it a highly nutritious soup. The eating of this strange creature exemplifies the statement already made, that of all omnivorous creatures man surely stands at the head of the list, and that at some time or another in the history of the race almost all of the various kinds of animate creatures have served to appease his hunger—the only sorts man has rejected being those found to be absolutely harmful.]



SEA URCHINS.—Small marine creatures, simple in organization and beautiful in form.

PART III—Continued.

Section 2.—Clothing, Ornaments, etc., from Animals.

CHAPTER XXV.

Materials from Animals.

N a former chapter we have already explained how it is that those wild people who depend for many necessities of life upon wild animals, can not—as do those who raise their food and materials from the earth—remain long fixed in one spot. They must be nomads, or wanderers, so that they may follow the creatures whom they hunt, and renew continually the supply of things needed for themselves or their homes. It naturally follows that those peoples who wander, instead of having fixed dwellings, are the ones that extract the utmost possibilities of use from animal life.

THE ARAB IN THE DESERT.

Thus the wandering Arabs, or Bedouins, who have been driven (probably by stronger tribes taking up the better parts of the earth) into deserts where can be found little or no vegetation, except near the infrequent water-holes or wells that nourish oases, must have a means of getting about, and are compelled to depend upon their camels and horses. Undoubtedly, this dependence of man upon the animal, and the animal upon man, has affected the natures of both. The camel, particularly, has been both by nature and by man, trained to life in the desert, and for that purpose has been modified in many curious ways.

It is well known, for example, that it can store up

in its body both food and drink. When well fed, the camel acquires a store of fat which accumulates in the form of a great hump or humps upon the back. It has also been so changed in its stomachs that a supply of water can be carried in these receptacles, and what is needed for the body will from time to time enter into its system, the rest remaining simply in a sort of natural storage-reservoir made up of a set of cells.

Besides this, the animal's nose is protected by nostrils that can be tightly closed to prevent the entrance of small particles of sand that sometimes completely fill the air, being carried upon the winds. When a sand-storm overtakes a caravan, the camels will crouch close to the earth with nostrils almost closed, and wait patiently until the air clears again. Of course, even with all these precautions, if the storm lasts a long time, the animal must perish. In these storms the men have no resource save to wrap their heads closely in their robes, for, since mankind have invented ways of meeting such dangers, nature has not been forced to modify their bodies, as in the case of the animals.

Since the Arabs can carry about only what can be loaded upon their beasts of burden, it is impossible for them to gather together any large amount of property, and they must make the best possible use of everything. From the camel they derive meat, milk, camel's hair to weave robes, leather, sinews, and bones for various uses, and they make these take the place of many materials used by civilized races. Every bit of waste from the animals can at least be used as fuel, for, in the desert, everything soon parts with its water and becomes dry and inflammable.

A little reflection will show that the Arab thus can fill nearly all the needs of his life from materials furnished by the "ship of the desert." Consequently, if they can but pass over the great spaces between one oasis and another, and can occasionally come upon a



A HERD OF WINNEPEG BUFFALO.

clump of date-palms, or, possibly, raise a quick-growing crop of grain, the Arab family has all that existence requires.

THE INDIAN AND THE BISON.

In speaking of the great herds of bison that within a few generations wandered over the American prairies, we have pointed out that the Indian, like the Arab, could obtain from a single animal nearly all of the few things required to support life. It has resulted, naturally, that in each case, the plains Indian and the bison, like the Arab and the camel, can hardly be thought of apart.

It seems at first sight puzzling that the American Indians recognized, by many a folk tale or a religious dance, or similar observance, the importance of the bison to his people, while we know of nothing similar showing a sentiment existing in the Arab toward the camel. But the American Indian lived in great groups, and it is in such circumstances that public ceremonials arise. There could be no such celebration in a single Arab family, or in a small group such as could remain together in the desert. Whatever of sentiment existed among the Arabs, showed itself by a strong feeling of pride and affection toward the beautiful horse that, as many a writer has told us, received little less care than a member of their own families.

A third example of such a close dependence upon animals is seen in the life of the Eskimos and other tribes dwelling in the extreme North, though in this case they are dependent upon a number of animals rather than upon any one. To them the seal and the walrus are the first necessities of life, while the polar bear and many smaller Arctic animals and birds supply variety to their diet, and help to cultivate the ingenuity of these clever people in devising traps, for the Eskimos are both an ingenious and an artistic people, and have contrived out of the simple materials they

can obtain, a number of the most ingenious traps and snares suited to their country.

Thus they capture the polar bear by propping up great blocks of ice, so that they will fall when a bait is taken; they snare the Eskimo foxes and hares; they net the birds, and to slay the wolves they enclose in frozen balls of meat a sort of spring made of whalebone, so that when the bait is eaten the whalebone will cause the animal's death.

The blubber and fat, indeed all edible parts of these animals, go into the cooking-pot that has been made from slate or soapstone, and are cooked by the burning oil from blubber, the flame melting from a piece of blubber the oil needed to supply it, even while the cooking is going on.

The hides and skins and the feathers of birds, make warm clothing, without which life could not be endured. The sinews and thongs cut from seals are used to fasten all their contrivances together, taking thus the place not only of our cord, but of nails and screws. From the interior organs and entrails they make all sorts of receptacles to hold whatever they need to carry about, and even the claws and bones are most ingeniously fitted into the best shapes to furnish them with weapons and tools. One may say again that no part of the animal is wasted.

It is worth your while, when at a museum some day, to examine carefully the making of such a marvelous piece of work as an Eskimo harpoon. Notice how the short pieces of bone are lashed and dovetailed together, wrapped with sinews that in drying contract and hold firmly as wire; see the long thongs of twisted leather that enable the hunter to recover the weapon after it is thrown, or to prevent the escape of the animal that has been speared; notice the bladder that is blown up into a float and attached to the cord of the harpoon to keep the speared creature from diving long beneath the sea.

One might in the same way point out what a wonderful bit of contriving is the kayak, or skin boat, made of thin skin stretched over a light framework—one of the most seaworthy little craft in the world. And no less wonderful is the sledge, which, in the old days, was constructed almost entirely of bone, with here and there a precious bit of driftwood found on some shore, worked into the frame. These sledges were shod with ivory or bone where the points of greatest wear came, and being rubbed with ice to coat the runners, traveled quite as well as if mounted on steel. Nearly everything that the Eskimo makes, combines great strength with the power of yielding to a strain that fits it marvelously to its purpose, and yet throughout a larger part of the year the Eskimos are utterly dependent upon what is furnished them by the animals they can capture.

WHAT THE ANIMAL FURNISHES.

These illustrations of peoples dependent upon animals will give us an idea of the use made of various parts of animals. These can be, in general, spoken of under a few main headings. Thus we may note the wonderful substance, ivory, that is really a special kind of bone formation found either in teeth and tusks, or in the long spear of the narwhal, and all these are practically only teeth. This substance is tough, hard surfaced, compact, and yet can be carved into shape, for it is not brittle. It is to many savages the nearest thing to a metal, and serves many of the same purposes. It has also been for ages a cherished substance among all mankind, bearing a high price and being procured at a great cost of labor and life, either for use or for sale in the market.

In very recent times the chemists have given us a number of substitutes for ivory which have hardly come in time, for the price of ivory is constantly rising, owing to the destruction of the animals from

which it is taken. Much old ivory came from the tusks of prehistoric mammoths and mastodons, or from the herds of elephants which, unless they are preserved from greedy hunters, must before long perish. The supply of smaller ivory will last longer, but no longer than men are prevented from putting an end to wild-animal life. Bone is often sold as ivory, but ivory may be told by its peculiar square-looking grain.

LEATHER.

The great value of leather to mankind is humorously summed up in the old saying that "there is nothing like leather." And, truly, it is a most wonderful substance when we consider that it furnishes us such a variety of fabrics, from the most delicate kidskin to great hardened hides that will turn the edge of a steel tool.

Leather was long used in warfare as a kind of armor, and, indeed, was probably the first substance so used, while it was not entirely given up until many years after metal armor had been discovered. Though no longer a protection in warfare, it still remains the great substance used in peaceful arts, where a tough and wear-resisting fabric is required.

Leather can be treated so as to be as flexible as cloth, or as stiff as the hardest wood. It will defy decay for ages if it is cared for, and now and then supplied with the oil that it gradually loses. Boots and shoes, gloves, book-covers, straps, trunks, and bags—there is no end to the demands of man for serviceable or beautiful leathers. It was the first clothing, and can never be entirely displaced. Though wild animals should cease to exist, we can still make shift with the hides and skins of domestic animals. But the sum total of comfort, of benefit, of safety and pleasure derived from its use, is beyond all recognition.

From the animal's outer covering of hair or scales, or from the horns and claws that the naturalist knows

are but forms of the same outgrowth which makes the hair and scales, come thousands of other articles that have played their part in civilization. Horns can be shaped and softened by heat or by boiling or other treatment, may be dissolved and hardened again to give various glues and gelatines. There is no end to the many ways these have been used.

Their chief value seems to lie in the fact of their resistance to moisture and to heat and cold. Before metal was so common, the hollow horn served the savage to keep his tinder dry, and the civilized man to hold his powder. It could be shaped into scoops and spoons, or used as drinking cups. Nor must we forget to mention how prominent a part horns and claws have served in ornamental uses. We need only recall how the old Norsemen, or Gauls, wore horns upon their helmets; how the American Indian wore a necklace of claws, or even tipped arrows with them. It may even be noted that when strung together, the hoofs and horns from small antelopes, for example, make rattles that play no small part in the mysterious rites of medicine-men among both the American Indians and the African savages. And we should not overlook the old inkhorn that for ages hung at the girdle of the business man or clerk, and was a sign and symbol of the skillful scrivener.

Incidentally we have spoken several times of the serviceable cords formed by sinew or other animal substance twisted and hardened. And also we have mentioned how the internal organs of animals have long been used to form pouches or bags that were mainly useful because they would not break like brittle pottery, and would protect their contents from moisture.

We despair of even mentioning the many minor uses of animal substances, such as the quills used in embroidery by Indian women, the tiny teeth pierced and strung as beads, the shells from marine creatures

that gave our own Indians not only ornaments, but their “wampum”—a currency that took the place of money, and, in particular, the exquisite feathers of birds that seem to have played all parts in giving mankind warm clothing, robes of state (as in the South Sea islands), fans and brushes, quill pens, and that guided the arrows that slew other wild creatures.

THE MOST IMPORTANT ANIMAL FIBERS.

For many of the substances already mentioned substitutes have been found in wood, in metal, or in plant products. But there is one animal product for which an equally serviceable substitute has not been produced. There is no other fiber that will in all respects replace wool.

Probably the earliest clothing was made from the skins or furs of animals, and nothing else was quite so durable and so warm. At first the skin with the hair or wool left on made garments that though rough were suited to the needs of savage peoples. But as time went on, men learned to get rid of the stiff leather part, and to use the hair and wool alone—these being not only warm, but light and flexible, instead of heavy and stiff.

The weaving of rushes and twigs led to the weaving of the grasses or twisted cords of bark; and from the weaving of thin tough grass it was but an easy step to weaving hair—such as that from the tails and manes of horses. So hair-cloth was likely to be made soon after men (or women) had discovered how to weave at all. Then followed the trial of other animal hairs, and when the wool of sheep and goats had been made use of a curious discovery was made.

This discovery was the fact that wool was different from other hairs, and could be made to unite—one fiber with another. If wool-threads are twisted and beaten together, they join firmly into the substance we call “felt,” and then can be subjected to rough usage without coming apart.

Many savage peoples have learned how to make felt, and out of it can form clothing, blankets, hats, bags—even tents, out of great mats that are applied to a framework of sticks.

SPINNING THREAD.

But though felt served many of the purposes of cloth, it was bulky and heavy. The next use of wool was discovered, it may be, in the same ancient times; or even earlier than the making of felt. By twisting the fibers tightly together they would make woollen thread or yarn, and this was done with the fingers, the fibers being drawn from a mass, and then twisted tight. To help in twisting, a stone or other weight was fastened to the thread and set to spinning. Old pictures show young girls with distaffs, spinning thread in this way.

Long ages later came that great invention, the spinning-wheel, for doing this same work; and so constantly did maidens make thread that they were known as spinsters—a name that has outlasted that form of thread-making.

WOOLEN CLOTH.

Out of the yarn or thread could be made the woollen cloth that had much of the warmth of animal furs, and yet was lighter, thinner, and could be cut into neater shapes, and more easily sewn into garments.

And woollen clothing has a great advantage over all the important vegetable fabrics in its greater resistance to heat. Heat does not pass easily through woollen, so it keeps in the warmth of the body, enabling us to wear less and yet to be comfortable, whether in winter, when the outside air is colder, or in summer, when it is warmer than ourselves. And—another great advantage—woollen does not wet easily, and does not conduct heat even when wet so rapidly as do cotton, linen, and thin silk. All this made woollen most desirable for clothing and for all fabrics where

warmth was sought, as in blankets, rugs, carpets, curtains, and so on.

THE VALUE OF SHEEP AND GOATS.

Considering then their wool and their flesh, both greatly desirable, we can see why men from early times have kept great flocks of sheep and counted them as a form of wealth. Many races have needed little other property than their sheep, since they could exchange wool or cloth or the tender lambs for what they desired. Such peoples are called "pastoral" races, from "pastor," the Latin for a shepherd.

Goats, too, were greatly valued for similar reasons, though goat's hair is not so good for clothing, nor is their flesh as much liked for eating. When the flocks were endangered by wild animals, such as wolves, it was found that the goats often served to protect the sheep, as they were braver and did not fear to attack with their sharp horns. Goats, too, would thrive and find a living in rough and hilly regions where sheep could not be supported in large numbers.

As to the keeping of sheep, the subject is far too large to be treated here. Like other domestic animals, they have been greatly changed by breeding, some are especially fitted for wool-bearing, others for producing good mutton. They thrive better in some lands than in others, needing a climate cold enough to make them raise good thick crops of wool, and yet not too cold for the plants on which they feed. England, for example, has always been a great wool country, and has sent the finest woollens to all parts of the world. At one time, sheep became so profitable that many farms were changed into sheep runs, and the farm-laborers dismissed except for a few shepherds. This caused many poor men to lose their chance to earn wages, and led to much misery.

The woolen industry today, like all others in the most civilized countries, has been made into a great

system, and employs thousands upon thousands of persons in the enormous factories that turn out the countless bales of woolen goods and then convert these into clothing, blankets, carpets, rugs, curtains, and other well known commodities for which we must thank the sheep that under the care of shepherds and their dogs so busily crop the green fields and meadows.

There are many fabrics derived from hair or wool, and a few of these come from unusual sources, such as the camel or the alpaca (a kind of llama); but nearly all of these can be closely imitated, and most of the "woolen" cloth we use is either woven from sheep's wool alone, or has a mixture of other fibers—as cotton, linen, or silk—added to make the cloth cheaper, or more suitable for its purpose.

So among all the animals that furnish materials useful to man there is hardly one so valued as the sheep.

CHAPTER XXVI.

Insects and Their Products.



ALTHOUGH in numbers of species and in plentifulness the insects exceed all other forms of life, yet they have not, except in a few instances, been found directly useful to mankind, and certainly not in any way that man directly brings about. Indirectly, we owe to insects perhaps more than to any other animals. If one will realize for a moment how these little creatures are busied everywhere, carrying away or eating up all forms of decayed substances or small particles that would decay if they were left to themselves, we shall see that the insects, above all things, are our most helpful scavengers. Their labors help to keep the world sweet—are needed to make it wholesome.

As soon as any form of vegetable or animal life dies, or becomes so weakened that its parts or tissues threaten to decay, flying and creeping things attack the waste substance, and either consume it or change it into a form that is harmless. Even the house-fly, that is so blamed for its power to carry disease, is, in reality, engaged in this good work of removing harmful waste, and picks up the disease germs through no fault of its own. Under the right conditions of living, whereby all harmful substances could be kept out of the reach of flies and other insects, we should find even these small creatures doing us good instead of harm; even now their work is of great value.

Another enormous service that is rendered by these little creatures—some hardly visible, others veritable giants among their kind, like the great moths—is the carrying of pollen from one plant to another so as

to make the seeds grow. It is less than two centuries ago that we learned how much was done by insects in bringing about the growth of plants.

The subject, thus opened, has led into a most fascinating field of study, has revealed to us some of the most marvelous contrivances in plant life, and has even taught us why it has been impossible to raise certain valuable plants in climates that seemed well suited to them. That some plants should thrive, it is necessary to have them visited by the one species of insect able to put the pollen just in the place needed, and where this has been learned crops can be raised by seeing that the right insect shall visit the flowering parts and apply the needed pollen.

Of course, not all plants need insects to do this work for them, but a very large part, and especially some of the most admired flowers, must have their insect visitors. Therefore, we have to thank insects for the continuance of a very great number of plants useful and ornamental—and thus we owe to insects, indirectly, not only many vegetable foods, but much vegetable material.

Of honey and wax we have spoken; even superior to these is that wonderfully beautiful insect product, the silk fiber. There have been attempts to make cloth out of a number of fibers spun by insects. Some of these experiments succeeded, more or less, as with the web of certain spiders. Though the spider is not truly classed among insects, yet we will mention this fabric here. But for one reason or another, these fabrics failed to be beautiful, to be durable, or to be made into thread without too much trouble. Often the cloth was too expensive, or it did not wear well, or failed to take dyes properly.

The fiber that is taken from the cocoon of the silkworm (here, again, the right name is not “worm,” but larva) proved to be perfection as a material for making the strongest and finest fabrics that could be

imagined. By twisting the fibers together, the threads of silk can be made of almost any desired thickness needed to weave either strong or fine cloth. The silkmoth can be readily cared for, is not often subject to disease when kept in captivity, and is easily provided with food, as it feeds voraciously upon the leaves of several species of trees, those of the mulberry-tree being the best.

The process of silk making is, to some extent, familiar to everyone. It consists in allowing the larvæ or "worms" to spin their cocoons, and then, by plunging these balls of the finest silk into scalding hot water, to kill the creature inside, since if it were left to eat its way out, the silk would be ruined. While still immersed in water, women who are trained to the work, pick out several loose ends of silk floating from the cocoons, attach several of them to a single reel, and in this way wind off the lengths of the fiber until their reels are full enough. Each cocoon consists of a single very delicate thread, which can be twisted with others.

Of course, the fiber has to be thoroughly cleaned, but it is strong, stands washing well, and when cleaned can be spun or twisted into fine thread, or into the strongest cords.

For a great number of years the silkworm was raised only in the Orient, and the secret of treating the fibers was jealously kept. The Orientals made a handsome profit upon the beautiful fabric, and dared not let the visiting foreigners secure any of the prized cocoons. At length, two travelers, monks, succeeded in stealing a number of cocoons, and by placing them in hollow canes of bamboo, and using these as walking-staffs, succeeded in escaping with their prizes, thus introducing the industry of silk-raising into Europe.

What silk has become to the whole world it is not necessary to point out, since the high value attached

to this beautiful cloth is proof enough of the estimation in which it is held. With the modern methods of spinning and weaving, silk can be made into fabrics that seem magical in their beauty, and that possess every good quality of which cloth is capable. So for the fabric that is most useful to the world, next, at least to cotton and linen, and probably superior to the latter, we have to thank the insect-world.

THE COCHINEAL INSECT.

Besides the silk-moth and the honey-bee, there are very few insects of much direct benefit to mankind, save in the general ways already mentioned. There is, however, one from which is prepared a valuable dye, a scarlet color that in various ways can be changed to crimson, orange, and other tints, and even violet. This insect, the cochineal insect, is found upon a species of cactus, especially one kind that grows in Mexico and Peru. This dye was introduced into Europe by the Spaniards who found it in use among the native Mexicans whom they conquered; and it was received with great favor, Cortes, the Mexican leader, being ordered by the Spanish sovereign to procure as much as possible.

For many years the nature of the dye was not known, but a clever Dutch microscopist learned that it was an insect which furnished the color. The dye is prepared from the bodies of the females. The insects are brushed from the cactus plant, and then killed, either by the heat of the sun, by steam, or in an oven. From the dried bodies the dye-stuff is prepared. Besides those that are gathered from the wild plant, there are great plantations of this cactus upon which the insects are specially raised with the greatest care. The dried bodies of the insects are placed in a vessel with ammonia water, and the vessel is then put into boiling water so as to cause part of the ammonia to evaporate. What is left is known as "cochineal paste," and is ready for use in dyeing.

Another insect that yields a valuable dye is that known as the lac insect. But in this case the dye-stuff is a crusty compound formed on twigs and branches by the insect. It is, in fact, a gummy sort of cocoon which surrounds their bodies. The lac-dye comes into commerce in small square cakes, and is much like cochineal, though giving less brilliant colors. It is mainly used for dyeing silk and wool, and though known for ages in the East, has been known to Europeans for perhaps not more than two centuries.

There is also a small beetle known as cantharis, which is found upon trees, and is used in medicine, to prepare blisters.

These few insects certainly are the chief ones worthy of mention, and though they are so few, we must not forget the importance of the substances we owe to them. Silk, honey and beeswax, at least, are hardly likely to be replaced by any substitutes. Formerly the oak-gall, produced on the oak-tree by an insect's sting, was of value in ink-making, but chemicals have taken its place and have made it of little importance. Elsewhere we have spoken of the species of insects that are eaten, and also discussed those that are capable of much mischief. It is the harmful insects, our enemies, that are most worthy of study, since they are capable of enormous mischief unless they are controlled.

PART III—Continued

Section 3. Animals as Man's Helpers and Friends.

CHAPTER XXVII.

In Travel, Transportation, and the Industries.

FROM the earliest recorded times, and even before then, men have been lazy; they have not wanted to work more than pressing necessity actually compelled. This may plainly be seen today in savage tribes, where the men, except on the hunt or in war, exert themselves but little, leaving the tilling of the fields and the bearing of burdens to the women. This has always been the case, and, in the beginnings of things, it is probable that women were made to do all the work: if a primeval family or tribe shifted its hunting-ground the women carried what scanty belongings they owned, a few skins and furs, some rude cooking-pots, a rough net for fishing, the babies, astride their hips or slung to their backs, as they do now in uncivilized lands, while the men strode along carrying only their clubs and spears and bows, on the lookout for game, or for an enemy.

By and by, as the world progressed and men began to accumulate a greater store of portable property, they saw that there was too much for the women to carry, and that they would have to carry something themselves, if they could not find some other way of transporting their possessions; this is probably when and why they began using the beasts of the field as beasts of burden. One of the hardest problems of

primitive people on their upward way toward civilization, was that of obtaining some kind of strength which could be added to their own. They found that animals were swifter than themselves; they wanted something stronger than women to bear the burdens and to break the sod: thus the ox, the ass, and the horse became domesticated.

BEFORE HISTORY BEGAN.

No one knows when animals were first domesticated for the comfort and pleasure of men; it was long, long ago in the days before history began to be written. The bones of the dog have been found with those of the earliest cave-men; the first reference to horses and asses, to cattle and camels, in written history, shows that these animals had long been tamed and trained, probably through centuries past; carvings and clay records in buried cities of Babylonia, cities that were old and buried and forgotten before the civilization of ancient Egypt began, before the days when Abraham went to the city of Ur of the Chaldees, show that dogs were trained for the chase, that cattle were used for ploughing, that camels bore burdens upon their humped backs, and that the horse was used to carry a rider, or to pull the rattling war-chariot. It needed many, many years to bring these things about, not only to change the beasts from wild animals to obedient servants, domestic through heredity, but for men themselves to learn how to do this thing, for primitive man was not swiftly inventive; it needed a long time for him to conceive a new idea, and the how and why of new things penetrated but slowly to his childish brain.

Scientists tell us that the dog was, the world over, the first living possession of man beyond the limits of his own kindred. The first dogs, perhaps, were wild puppies, caught by savages and carried to the home cave. Whether the dogs were wild dogs originally or

whether they were domesticated wolves which gradually lost all their wolfish characteristics, is a question for the biologists to wrangle over. After the dog came the ox, the ass, the horse, the camel, and the elephant.

HOW MEN TRAVEL.

Before the days of railways and steamboats, of automobiles, and aeroplanes, men did most of their traveling on their own legs or by the aid of animals: animals, also, carried the burdens, at first in packs upon their backs when there were no roads, or else but few, and those very bad; later came the drag, or "travois," the sledge, the solid-wheeled cart; then the wagon and the carriage. Where modern methods of steam and electric transportation do not exist, all the travel and transportation must be done by beasts of burden. There are many sorts of animals used for this, and many methods of accomplishing the same end, from the savage dogs which whirl the bone sledges of the Eskimo over the icy wastes of the frozen North, to the homely camel of the burning Sahara; from the great elephant of steaming India, to the shaggy llama of the snow-clad Andes.

Of all the animals of travel and transport, of use and pleasure, the horse is foremost. Modern statistics have it that there are in the world today approximately one hundred million horses. Of these, eighty millions, or four-fifths of the entire number, are found in the temperate zone, and nearly all among occidental people, while the remaining twenty millions, scattered through the tropics, are largely employed in the service of temperate-zone visitors or residents. In the United States and Canada there is one horse to every three and one-half persons; in South America, one for every seven; in Mexico, one for every twelve; in Japan, one for every thirty-three; in the Philippines, one for every fifty; in Africa, one for about every one

hundred and fifty; in India and China, one for every two hundred. The scarcity of horses in tropical countries is due chiefly to the fact that they do not flourish there; and in the Orient, to the fact that the crowded population forbids the utilization of enough land for the production of its food.

Taking the place of horses, through tropical and oriental countries, there are, approximately, twenty million buffalo or carabaos, ten million donkeys, and about three million camels. And almost everywhere is found the patient, plodding ox. These are the chief animals of transportation of the world. Elephants are used to some extent, as are dogs and llamas, but these are confined to comparatively restricted regions, and their use is not universal.

THE USES OF THE HORSE.

It was thought, formerly, that the horse had its origin in the region of Central Asia, which seems to have been the original home of many of our modern nations, but more recently scientific opinion has inclined to the belief that the horse, or the little prehistoric animal, the *Eohippus*, from which our modern horse developed, was found in North America, and that it, or its descendants, found a way to Asia over the land which once connected this country with that continent, between Alaska and Siberia. At any rate, the horse, or horse-like animals, disappeared from America, and there were no horses here until the Spaniards brought them over the sea.

At first the horse was probably used for riding and for war, rather than as a beast of burden and draught, that work being left to cattle, donkeys and camels. The horse was swift and enduring, good for long journeys; it was beautiful and high-spirited, fitting it for war. Early sculptures, indeed, show that these were the uses to which it was put; asses and oxen were depicted as doing hard labor, but the horse,

with head erect and prancing hoof, bore the prince or the warrior on its back, or swiftly drew the war-chariot and the fighting-man into the thick of battle. In one of the oldest of written books, the Book of Genesis, Miriam, in her song of triumph over the destruction of the Egyptian army, sings, "The horse and his rider hath He thrown into the sea"; and again, in that great poem, the Book of Job, the horse is described as a creature of war:

"Hast thou given the horse strength?
Hast thou clothed his neck with thunder?
Canst thou make him afraid as a grasshopper?
He paweth in the valley and rejoiceth in his strength:
The glory of his nostrils is terrible!
He goeth on to meet the armed men.
He mocketh at fear and is not affrighted;
Neither turneth he back from the sword.
The quiver rattleth against him,
The glittering spear and the shield.
He swalloweth the ground with fierceness and rage;
Neither believeth he that it is the sound of the trumpet.
He saith among the trumpets, Ha! ha!
And he smelleth the battle afar off, the thunder of the
captains and the shouting.

Oxen were used for the transportation of men and goods before the horse, but it was found that the horse was better for arduous, long continued labor, also swifter. The cloven hoof of the ox is weaker than the solid hoof of the horse; it is apt to get sore on a long march, even over good roads, though the ox is not carrying a burden, while the horse's hoofs do not. An ox can carry on its back from one hundred and fifty to two hundred pounds weight, while the horse will bear two hundred to two hundred and fifty pounds, endure a long trip better, and travel more swiftly, an ox going only half as rapidly as a walking horse.

The horse has been preëminently the animal of the Anglo-Saxon and other North European races. The ox, used in very early days, proved too slow for the

- always energetic Anglo-Saxon, and the horse supplanted it to a very large extent. The horses of earlier days were smaller and lighter than those used afterward; the horses of the Greeks and Romans, of the Persians, and of the nomads of Eastern Europe, were rather light, active animals; the heavy horses were bred to carry the heavier men of the North, especially in the times when men went out to battle sheathed in heavy armor. The need for a strong, heavy horse resulted in the great Norman type, from which come the Percheron, the English Clydesdale, the large Flemish horses, all of them familiar kinds of heavy draught horses. The onset of a knight clad in complete armor, mounted on one of these heavy horses, itself partly sheathed in iron, must have been formidable, and, from the momentum of such a mass, hard to withstand, although they must have been comparatively slow, so that when Sir Walter Scott tells us, in describing the tournament at Ashby, that "the champions vanished from their posts with the speed of lightning" it is probable that he had an eye more to the picturesque than to the fact.

PACK-HORSES AND PACK-TRAINS.

Before there were any good roads in Europe or in this country much of the travel from place to place was on horseback. The merchant made his trips on horseback, with his wares carried in packs on the backs of horses; Chaucer's pilgrims to Canterbury went a-horseback; the soldier rode to war; the farmer rode his stout nag to the market-town, with his plump wife seated on a pillion behind him. Kings and queens traveled on horses when making progresses through their kingdoms. A little later came the horse-litter, an enclosed and ornamented box on two poles, which were fastened to the girths of horses, one in front and one behind the litter. These litters were used for ladies and for great persons. Such litters are still to be found in China, where they are usually borne by

donkeys; and, in Egypt, Arabia, Persia, and India where they are borne by camels or bullocks.

The transportation of merchandise, food and wares of all sorts, by pack-trains has very largely been discontinued in all those countries where railways are numerous, especially in America, where the long distances practically prohibit the hauling of freight by animal-motive power, as being too slow and too costly; the pack-train is still used, however, in certain mountainous portions of the far west; in England and in certain European countries, where the roads are generally far better than in America, and where the distances between towns are not so great, much freighting is still done in wagons drawn by powerful horses. Anyone who travels in England can not fail to notice the large wagons, piled high with all sorts of bulky articles, en route from town to town, drawn by two or three large horses, their silky manes braided and combed and adorned with bright ribbons, driven by a carter in a faded smock. In France and Germany also this method of transportation is largely used.

In the days before railways were built, but after the highways had been improved, travel was mainly by private carriage or by stage-coach, in England, and by carriage or diligence, a sort of lumbering coach, in Europe. On the stage-routes relays of horses were kept at the different towns along the road, and the old coaches swung along, with two or four horses, at a rate of from six to twelve miles an hour. The stages had seats inside and on top, and a small amount of baggage for each passenger was carried in the boot, a contrivance of heavy leather at the back of the coach. Heavy luggage was sent by the carrier. The stage, or coach, has practically disappeared, except as sport for the wealthy, and the lumbering diligence is vanishing also before the advent of railways, electric lines and automobiles.

In American pioneer days the thousands of hardy

men who crossed the Alleghenies in the search for homes carried their household effects on pack-horses, along the rough trails or where no trail existed. Sometimes the man and his family went alone, the wife and children and the scanty goods and chattels borne on horses, while the man marched ahead, his long rifle thrown over his arm, keeping a wary lookout for the painted Indians who beset their path. Oftener, however, the pioneers banded together and traveled with a long train of horses, guarded by a score of keen-eyed riflemen. In later days, when roads had been built, great wagons took the place of the pack-animals, wagons drawn by teams of four, six, or eight horses. Many a person now living remembers the trains of Conestoga wagons, so called because first built at Conestoga, Pennsylvania, borne on high, broad-tired wheels, the wagon-body rising fore and aft like a boat, covered with a canvas tilt, or top, stretched over hickory bows. In such wagons were transported the goods of the people who settled most of the great Northwest Territory; and in such wagons, then called "prairie schooners," traveled the venturesome men who traversed the almost unexplored plains of the great west in the rush to California after discovery of gold in 1849.

The farmer uses the horse to haul his produce to market, to take himself and family to town, to church, to see their neighbors; children ride the shaggy ponies from the Shetland isles; horses draw our pleasure vehicles, and are used in many forms of sport, in riding, for hunting, in polo. The American trotting-bred horse furnishes excitement in harness-racing; and the thoroughbred is raised and trained for racing in this country, England and Europe. The cowboy of the West would be lost without his hardy cow-pony; while the Cossacks, the Kurds, and other tribes of Eastern Russia and Central Asia find in the horse not only a means of travel and transport, but use the mares' milk



1. A fellahen carrying his produce to market.
2. A fellahen farming with his primitive plow.

for drink, horseflesh for food, and horsehide for tents and clothing. No factor has been more important in the settlement and civilization of Europe and America than the possession of the horse, the animal best adapted for travel and transport in the temperate zone.

A LONG-EARED FRIEND.

Like the horse, the use of the ass, or donkey, by man, runs back to immemorial times, and it is probable that it was domesticated prior to the horse. Asia was probably where the donkey was first brought under man's dominion, and it is in the Orient, in Southern Europe and in Latin-America that it is most extensively used. Wild asses are found today in Mesopotamia, Persia, Cutch, Arabia, and in parts of India; swift, shy creatures they are, very different from the fuzzy, patient, long-eared little animal most familiar to us. It is these wild ones that are referred to in the poem of Job:

“Who hath sent out the wild ass free?
Or who hath loosed the bonds of the wild ass
Whose house I have made the wilderness,
And the barren land his dwelling?
He scorneth the multitude of the city;
Neither regardeth he the crying of the driver.
The range of the mountains is his pasture.”

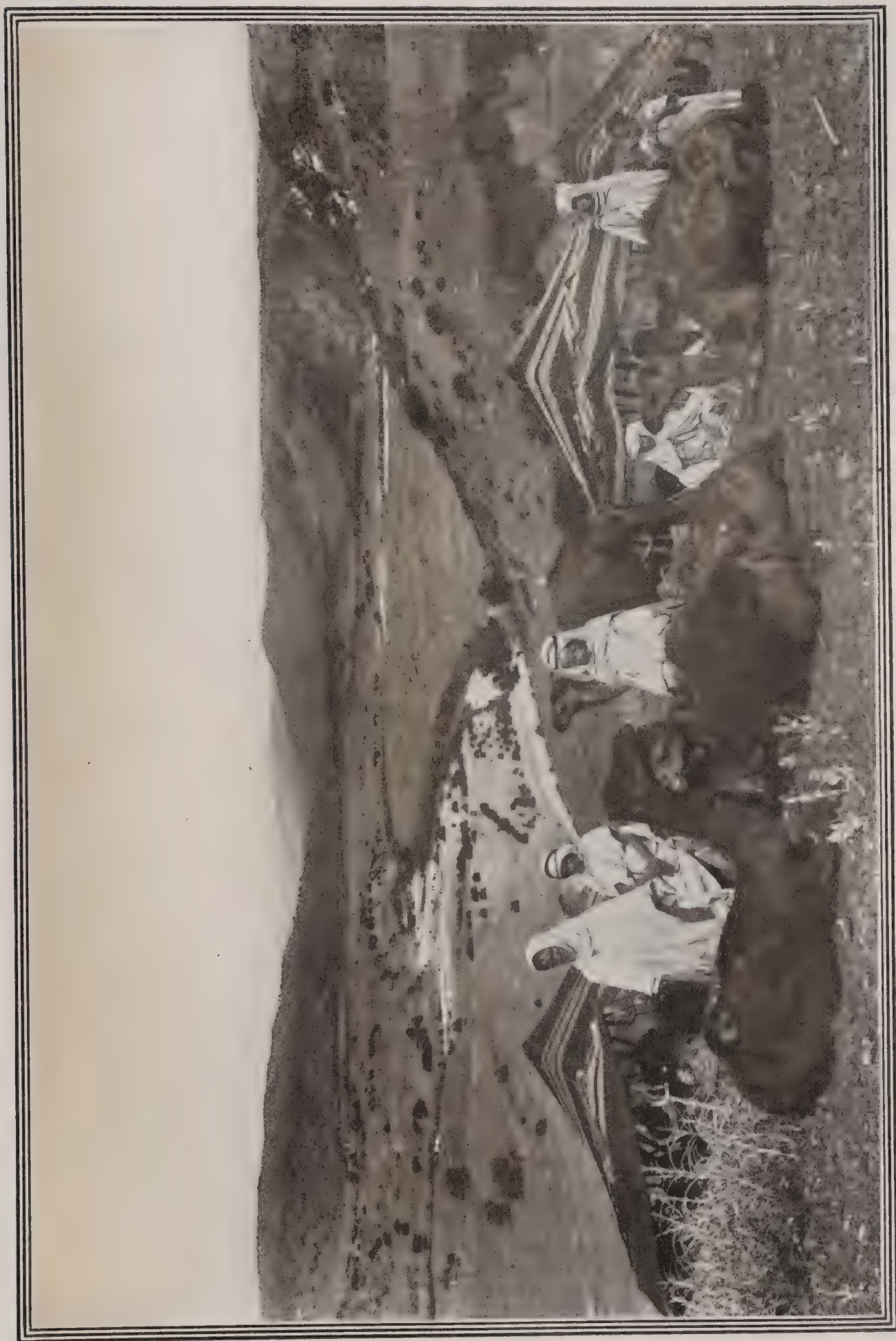
The ass, when properly looked after, becomes a fine and spirited animal, as in Southwestern Asia, in Egypt, in Spain, Italy, and Malta. In early days it was a beast of honor; and a Biblical writer appeals to those “who ride on white asses” as if to persons of consequence. In the countries named above, the well-bred ass is used as a riding-animal, and is swift and well-paced. It is also used thus in certain parts of South America. They were used, also, in old times, to draw wheeled vehicles, since, in the Old Testament, there are references to “chariots of asses.”

Donkeys are hardier than horses, eat less and

rougher food, and are better for pack-animals, especially in mountainous countries, as they are far more sure-footed. The donkey is passing away in carriage-using, railroad and automobile countries. There are probably millions of people in the United States who have never seen a real donkey, though mules are common.

Statistical records indicate the existence of about ten million of these small and patient burden-bearers scattered over the world, chiefly in Latin-America, Northern Africa, Arabia, and the Holy Land. The ass was taken into Spain by the Moors, and thence spread over Europe, and brought to this country by the Spanish explorers. In Mexico the donkey, or "burro," is everywhere in evidence, as preëminently the beast of burden of that land. Its little round hoofs plough up the dust on country roads, or click-click over city streets; its long ears nod above its patient face as it moves along beneath immense loads of forage, vegetables, fire-wood, baskets, pots and pans, the load being often so large that all that can be seen of the burro is four pattering hoofs. They are largely used in the mountains, being more sure-footed than the horse, and also less liable to the causeless panics of fright which so often affect that animal. Burros travel a distance of from ten to twenty miles a day, according to the condition of the road, carrying loads of from one to two hundred pounds each. In many of the mountain regions the burro is the only available method of transporting ore from the mines to the smelter, or to a railway, and of bringing back supplies. A loaded burro-train, accompanied by the drivers in the picturesque Spanish-American costume, makes a quaint and interesting sight as it winds along a narrow mountain trail or through a tropic valley.

The mule is the offspring of an ass and a mare; it is larger and stronger than the ass, and better fitted for rough work than the horse. It is especially well



ENCAMPMENT OF A CARAVAN.—Most caravans are formed for purposes of trade, merchants traveling together across the deserts of Asia and Africa for mutual protection; but the best-known caravans are those formed of pilgrims to Mecca. A caravan sometimes has as many as a thousand camels.

known and largely used in the Southern and Western parts of the United States. It takes the place of the horse in parts of South America, Southern Europe, and in parts of the Orient. The mule is generally esteemed a stupid, dull-spirited animal, but this is owing to its generally neglected state; as a matter of fact the mule possesses more intelligence than a horse, and, with proper care, becomes a handsome and spirited animal. In America it is mostly used for hauling and for farm work. In the United States army it is the animal used for hauling wagons and ambulances, for packs, and, in mountain batteries, for carrying dismounted, quick-fire guns upon its back. The English army puts it to the same uses. All armies use the horse as mounts for their cavalry, but the mule plays so prominent a part, especially in America, that the phrase "army mule" has grown to be of common use.

THE CAMEL AND ITS COUSINS.

One of the oldest animals on earth, one which has undergone the least change from the type of its prehistoric ancestors, is the camel, and its cousins, the llamas, vicunas and alpacas, of South America. That it is one of the earliest of domesticated animals is evident from the frequent allusions made to it in the oldest written records of the human race. Six thousand camels are said to have made part of the wealth of Job; they also formed part of the present which Pharaoh gave to Abraham; and it was to a company of Ishmaelites, traveling from Gilead to Egypt, on camels laden with spices, much as their Arab descendants do at the present day, that Joseph was sold by his brethren.

It is as a beast of burden and of transport that the camel is chiefly valuable; its elastic, padded hoofs are especially fitted for travel over the loose and shifting surface of the desert sands; it can exist on the

scantiest of food, carrying a reserve in the hump on its back, which diminishes in size if the animal is compelled to go without food. It can also carry a reserve of water in the cells in its stomach walls, for use when wells are few and far between. Its nostrils are mere slits in its nose, and can be tightly closed to exclude flying sand. But for these qualities in the camel, which make it so peculiarly adapted for use in arid regions, vast tracts of the earth's surface would have remained unexplored and unutilized.

In all parts of that great line of deserts, stretching from North Africa across Central Asia to Northwest China, the camel is everywhere in evidence, the total number in the world being estimated at three millions. Here, in the midst of these waterless areas, the camel finds its highest usefulness. The camel's training as a beast of burden begins in its fourth year, when it is taught to kneel down, and get up, at command, and to carry increasingly heavy burdens, weighing from three hundred to one thousand pounds, according to the breed of camel employed, for there are many different breeds. When crossing a desert the camels are expected to carry their loads three days, without water, at an average speed of twenty-five miles a day; the fleeter varieties will carry their riders fifty miles a day for five days, without drinking. When too heavily laden the camel refuses to rise until some of the load has been removed. The camel is a stupid animal, docile on account of that stupidity. On occasion it is savage, and if it takes a dislike to a man will watch for a long time to get a chance to bite or trample upon him.

There are two species of camel, the single-humped, and the double-humped, or Bactrian. The latter is found to the east and the northeast of the single-humped, and is the species used in Thibet, around the desert of Gobi, in China, and for carrying wares across the snowy passes of the Himalayas into



1. The Alpaca.

2. Vicuna.

India. The dromedary is a variety of the single-humped camel, used as a riding animal, celebrated for its fleetness and endurance, more lightly built than the heavy freight-carriers, and capable of traveling one hundred miles a day.

If the weight-carriers, the slower camels, are called "ships of the desert," the dromedary may be said to be the palace-car of the desert, for when its owner and his family travel, it is in a light frame work placed on the camel's back and covered with gorgeous canopies. In wedding processions in Egypt, the bride is carried in a gorgeously-bedecked litter, slung between two camels, one before and one in the rear; the drummers, who are an important part of every well-conducted wedding parade, ride on camels that are decorated with colored stuffs, tassels, fringes, and tinkling bells. Camels are used for ploughing and for hauling rude wagons, generally mounted on two huge, shrieking wheels. A corps of the Egyptian army, under English direction, is mounted on camels, for service in the desert. For uncounted centuries the patient, stupid camel has borne his burdens across the deserts of the Orient, caravan after caravan traversing the shifting sands, bearing all manner of wares between the countries of the ancient world, but a day is coming when the highest usefulness of the camel will be past, for railways and automobile trains are usurping its hitherto unchallenged kingdom.

IN THE HIGH ANDES.

When the Spanish conquistadores first visited the Andean regions of South America, they found the people in the dominion of the Incas using as a beast of burden a long-necked, shaggy animal, with a family resemblance, except the hump, to the camel. This was the llama, cousin to the camel, and the only animal used, at that date, in either America, for transportation. There were no horses, no asses, no

domestic cattle; and the use of the llama was confined to the Andean regions. Modern science affirms that the camel family originated in America; that the ancestors of the camels of Africa and Asia wandered from America, by way of Siberia, into those other lands, while the llama and other members of the family, the vicunas, alpacas and guanacos, disappeared from North America and remained only in the Andes. The llama is the only one used for transport, the others being kept for their fine wool. The llama has the broad, split hoof, with elastic pads beneath, like the camel, rendering it especially fit for mountain climbing and for walking over sandy plains. It can carry from fifty to two hundred pounds, slung in panniers across its back, the panniers being woven of its own wool. The weight of the load depends on the age and size of the animal, and on the road to be traversed. Domesticated long ago, perhaps even before the days of the Incas, they are the best friends of the Andean mountaineers, furnishing wool for clothing, fuel, bearing burdens patiently, calling for little care, as they graze by the wayside as they travel, requiring little water. As in the days of the Incas, before the Spaniards came to destroy their kingdom, so today trains of laden llamas slowly journey over the high passes of the Andes, toward Cuzco, the ancient Inca capital, driven by the Quichua Indians, descendants of the old, old peoples who built the great walls and buildings, which are all that now remain of the once powerful and extensive dominions of the rulers of the Andes.

THE PATIENT, PLODDING OX.

Like the horse, the ass, and the camel, the ox was domesticated in prehistoric times, and has been ever since, one of the most valuable possessions of men and one of the great aids toward civilization. They are mentioned in the oldest written records of the

Hebrew and Hindu peoples, and are figured on Egyptian monuments raised two thousand years before the Christian era; while the remains of domesticated specimens have been found in the Swiss lake-dwellings along with the stone implements of neolithic man. In very early days cattle were kept for their milk, flesh and hides; later the oxen were used as pack-animals, each being capable of carrying from one hundred and fifty to two hundred pounds. This use has almost been given up, and oxen are now used as draught animals, but in South Africa, India, and parts of Central Asia the ox is still utilized in pack-trains, and even in the southern Appalachian system of the United States an ox may now and then be seen bearing burdens on its back, as in the days of the patriarchs.

There are two species of oxen, the humped, or zebu, and the common, straight-backed kind. The zebu is found at its best in India, but extends into Japan, and westward to the Nigerian region of Africa. In India the zebu is used as a riding animal, under saddle, and to haul carts, or splendidly caparisoned, quaintly-shaped carriages in which ride the women of the native nobility. In Ceylon is a special breed of oxen that have been trained and developed to trot: these, attached to light carts, make a speed that is remarkable. In South Africa an ox is often saddled, and used as a riding animal. The plodding ox-team is a familiar sight in Europe, England and North and South America, as well as in Africa and Asia. In the United States it is most common in parts of New England, in the South and Southwest. In the logging operations in the forests of North America great ox-teams, eight, ten or twelve pairs, straining at their yokes, are a conspicuous feature, as they haul enormous loads of logs. In the Middle West the ox-team is becoming rare. As steam-propelled vehicles and motor vehicles of various sorts became more common, and as roads improve, the slow-

moving ox-team will become rarer and more rare, although they will still be extensively used for many years to come in tropic and Oriental countries, where modern progress is not so rapid as in other lands.

THE FILIPINOS' FRIEND.

The carabao, or water-buffalo, is one of the most important factors in the agriculture and transportation of the extreme Orient. Originating in India the carabao has been transported westward as far as Egypt, and eastward through the Malayan peninsula, China, Indo-China, and the islands of the Indian Archipelago. The number among the Oriental peoples is estimated at fully twenty millions, and they are found in greater or less numbers all the way from Egypt to the Philippines.

Costing about one-half as much as an ordinary horse, or even less, in those countries, they perform all the services usually required of that animal; and their extreme deliberation in movement is compensated for by the fact that they can endure the heat of the tropics, while their fondness for water and mud renders them especially useful in the flooded rice-fields and on the muddy roads during the rainy season. They are used in every way that the horse is used in the temperate zone, attached to sleds, to carts, to drays, to carriages, and under the saddle. Their thick, brown skin, almost devoid of hair, gives little heed to the whip, but generally they are patient, docile, and friendly with the natives, but unfriendly to white men, and are of great service in the lands where they are found.

In the Philippine islands they very largely take the place of the horse, for in those islands the number of horses and ponies is estimated at only one hundred and fifty thousand, while there are over one million carabao. In towns and cities they are everywhere seen, and in the country, drawing heavy loads on carts

or drays, or standing patiently in the broiling sun, if they can but have an opportunity, once or twice a day, to wallow in the mud and water of some pond or stream. Without an occasional opportunity to submerge themselves in water they soon become unmanageable and even dangerous to those around them.

MY LORD, THE ELEPHANT.

It is only in India, Siam, and the countries immediately adjacent that the elephant is put to practical use for the comfort and pleasure of men; in Africa it is "big game" to be killed by hunters, while in other countries it is merely a curiosity and object of interest in zoölogical gardens or traveling menageries. Even in India and neighboring countries the use of the elephant is becoming less and less as roads have been built over which oxen and steam-propelled vehicles can travel. The fact that it requires large quantities of food, that it is peculiarly liable to disease in its domesticated state, that an elephant is seldom born in captivity, and that their loss must be replaced by captured wild elephants, militates against its practical use, although it is still used in comparatively undeveloped sections, where heavy work is required in handling timber, and in military service. An elephant can carry about a ton in weight, at a rate of four miles an hour, in a climate where a horse is comparatively useless for such purposes.

When new elephants are required, they are sometimes trapped, but the usual way is to drive a herd of wild elephants into a "keddah," or large enclosure, made of tree-trunks set deeply into the ground, and fastened together with heavy coir rope or tropic creepers, making so strong a fence that even an elephant can not break it down. The wild herd having been located, hundreds of native beaters, and men on tame elephants, surround it and begin driving it toward the keddah, going slowly at first so as not to

alarm the wild animals sufficiently to make them break through the cordon around them. Arrived near the mouth of the keddah, the beaters and tame elephants close in, and with the beating of tom-toms, the blowing of horns, the shouts of hundreds of natives, and, if at night, with the flare of many torches, the wild elephants are rushed into the great trap, the weaker ones often being killed or badly injured in the crush at the entrance.

When the herd is inside, the big gates, made of tree-trunks lashed together, are dropped behind them, and, as soon as the animals become a little quiet, trained elephants, directed by their drivers, or mahouts, enter the enclosure. Heavy ropes, with a slip-noose at one end, are slipped over the feet of the wild elephants and they are securely fastened to one of the logs of the keddah wall. Any wild elephant that shows fight is prodded or hammered into submission by the tame animals. Then the newly-caught animals are walked up and down, fastened, each one, between two tame animals, and are taken away to be trained to various sorts of work. That work consists in carrying heavy loads, in loading heavy weights into lighters or vessels, in pushing or hauling big guns or heavy wagons, and in handling heavy timbers.

THE INTELLIGENCE OF ELEPHANTS.

An elephant is easily and quickly domesticated. The most peculiar mental quality of the elephant, a feature which seems to separate it from the horse or dog, is the rational way in which it will do certain kinds of mechanical work. It seems to know the effect or result of its actions. In moving artillery over bad roads in India an able elephant will walk behind each gun and steady or lift it when needed without any command from the driver, knowing when help is needed. On one occasion a gunner fell from a gun, and would have been crushed by the wheel had not the

elephant behind promptly grasped the wheel, and lifted it across the fallen man. An elephant trained to pile timber will pile the heavy logs or timbers in neat piles, placing each layer alternately, with ends in opposite directions, as railroad ties are piled, without any detailed orders. A story is told of an elephant engaged in carrying heavy timbers that once, when so engaged, it encountered a horseman on a narrow way. With the timber being carried transversely of the narrow path there was no room for the horseman to pass, so the elephant, appreciating the situation, backed into the jungle at one side, until the road was clear, and then gave a trumpet as if to say to the horseman, "Come on."

THE STORY OF "OLD SOUP."

Another story is told of a famous old elephant named Soupramany, familiarly called "Old Soup," employed in loading timbers near Cawnpore, India. The children of an English officer, Major Daly, were playing near, when suddenly another elephant, becoming infuriated for some reason, rushed toward the children and would probably have killed them had it not been for old Soupramany which rushed between the children and the mad elephant, and fought the latter until it was beaten into submission. The wise old beast was often entrusted with the care of Major Daly's children, and used to watch over them as they fished from the bank of the river. On these occasions "Old Soup" used to be given a rod, which she held in her trunk, and fished as gravely as anyone, pulling up the line whenever the float bobbed under, though it is not told whether she caught any fish or not.

Elephants were domesticated at a very early period. Egyptian monuments of ancient days show Negroes leading African elephants into Egypt, but the African elephant is not used now-a-days except to be killed for its ivory tusks. The governments of India,

Siam and Burmah, protect the elephant herds most carefully, and none are killed. When Alexander the Great led his troops into Northern India he was opposed by King Porus who, besides horse and foot, brought against him eighty-five war-elephants, which at first frightened the Greeks, but did not ultimately prove effective. Pyrrhus, King of Epirus, one of the greatest generals of antiquity, had elephants in the army, which he took into Italy and with which he twice defeated the Romans; and so did Hannibal, the Carthaginian, who marched his war-elephants across the Alps and down into Italy. The Roman soldiers, however, rushed under the elephants and stabbed them with their short swords, whereupon the elephants turned about and fled in terror, doing much damage to the army they were supposed to support.

Elephants for travel may be hired in most Indian cities. Travelers are conveyed in howdahs, which are canopied platforms placed on the animal's back, or on seats, capable of holding four or five persons, there being two seats, one on each side of the elephant, running lengthwise. Elephants are also used in hunting the tiger, the hunters riding on the back of the elephant and shooting from there. The Rajahs and other native rulers and nobles keep elephants for their own travel and for processions.

IN THE FROZEN NORTH.

From the jungles of India to the ice-wastes of the far North is a long journey, and there is a vast difference between the elephant, the largest, and the dog, the smallest of transport animals, but without the hardy dogs of the North the story of North Polar exploration, from Frobisher to Peary, would be very different. The earliest Arctic explorers found the Eskimo, whose tribes extend from Greenland to the Behring Sea, using dogs as motive power for transport. These native dogs are wolflike in appearance

and generally rather savage, requiring stern treatment to keep them in order. The Eskimo habit is to harness from five to nine dogs to one sledge, made of bone, hide and sinews, each dog being fastened to the sledge by a separate trace of walrus-hide, attached to a collar of the same material. The dogs are powerful animals, it being recorded of one large dog that it drew a sledge and load, weighing one hundred and ninety-six pounds, a distance of one mile in eight minutes. They are fed once a day, in the evening, on frozen fish or meat, or, in Alaska, by white men, on a mixture of cornmeal mush and meat.

In Alaska the sledge dog has played a very important part in the development of the country. Horses can pull a heavier load, but horses can not well stand the extreme cold; and over broken trails, in deep snow, for long trips, the dog is far superior. In an account of transportation methods in Alaska, Captain George Gibbs, Signal Corps, U. S. A., says: "The dog plays a part in Alaskan life that is indispensable, and for which there is no other substitute. The United States mail is carried from one end of the country to the other by dog-teams. Miners have dog-teams which do all their hauling, fuel, provisions, trips to other camps and on prospecting tours.

"The United States military telegraph system, operated by the Signal Corps of the army, maintains a dog-team at each of the stations along its one thousand four hundred miles of land lines. These teams are used by the repair men in going out on the line to repair breaks. They carry, besides tools and material, a small tent, stove, bedding, and food for men and dogs. A few years ago different breeds of dogs were used in different sections, but increased travel has brought into use all of the dogs to be had in the country, and hundreds, in addition, have been brought from the outside. The native 'malamutes,' 'huskies,' and dogs from the Mackenzie and Peel rivers are

more hardy and last longer in service than dogs from outside. Newfoundlands, Saint Bernards, setters and sheepdogs are superior in intelligence, but they are lacking in endurance, require more careful feeding, and their feet are easily frost-bitten."

In Alaskan regions dogs are harnessed to the sledge in pairs, or in single file, the traces from each dog's collar being attached to the collar of the one next behind, those of the rear dog being fastened to the sledge. Seven to nine dogs will haul from four hundred to six hundred pounds from thirty-five to forty-five miles a day, under ordinary conditions. The driver does not often ride on the sled; he is usually anxious to haul as large a load as possible, and his entire strength and attention are needed to keep the sled on the trail, and, besides, in very cold weather continual running is necessary to keep from freezing.

In Newfoundland the dogs of that island are used as sledge dogs and as pack animals, carrying loads in panniers slung across their backs. The western North American Indians use their dogs in the same manner, as do also the Eskimos. The Indians, also, use what is called a travois, which consists of two poles fastened at one end to a girth and breast-strap on the dog, the other ends dragging on the ground behind. The poles are connected with a strip of hide, and on this was fastened the load. The same contrivance was used with the Indian ponies, being the main method of transportation, except the back of the squaws, when an Indian tribe shifted its village to a new location.

THE "HORNED HORSE" OF THE LAPPS.

All along the Arctic coast of Europe and Asia, the Lapps and Finns and the Siberian tribes use the reindeer as their means of travel and transportation. The reindeer is found wild all through the far north of

North America, where it is called the caribou; these have never been domesticated as have the reindeer of Europe. The Lapps have large herds of reindeer which constitute most of their wealth. The deer are usually harnessed in pairs to a sled, and two of them will haul from two hundred to three hundred pounds, going at a shuffling trot at a rate of about ten miles an hour. A pair has been known to travel one hundred and twelve miles in a day, a remarkable performance.

The United States Government introduced the Siberian reindeer and deer from Lapland into Alaska, thinking that they would prove valuable, not only as a means of transportation, but as food for the Alaskan Indians. Reindeer have also been introduced into Labrador. The first deer were introduced in Alaska in 1889, by the Rev. Sheldon Jackson, a Presbyterian missionary and Government inspector of education in Alaska. Lapp attendants were also brought over to teach the Indians how to use and care for the deer. Other deer were brought each year, until 1898, when five hundred and fifty had been imported. These increased rapidly, and in 1903 numbered about five thousand. They probably number twice that at the present time, or even more.

These deer carry loads slung in panniers across their backs, and help to carry the United States mail. They are also used for travel, and for hauling loads on sledges. Captain Gibbs, quoted above, says in a report: "The introduction of domestic reindeer into Alaska has given that country a new and useful animal, which is already becoming a source of comfort and enjoyment to the native Indians, whose condition in every way is deplorable. To them these animals will have some usefulness as beasts of burden, but for anyone to maintain that they are, or will become, an important adjunct to the transportation facilities of the country, is misleading. They have been tried for various sorts of work during a period of several years,

and have been unreliable and inefficient in comparison with horses and dogs.”

ANIMALS IN OTHER WORKS.

The first men who, in ages past, made a plough from a tree-bough and hitched an ox to it made a great revolution in agriculture. Were it not for the use of domestic animals in agriculture the production of vegetable food could not have kept pace with the increasing population of the world, and civilization would have been vastly retarded.

In the temperate zone the horse has been the main motive power for farming and for many sorts of machinery until very recent years, when its place has been taken, in many instances, by steam-driven machines. So universal was the use of the horse that the measure of the energy of machinery is still spoken of as being so many “horse-power.” One horse-power is the measure of strength needed to raise five hundred and fifty pounds one foot in a second. In tropical and Oriental countries the place of the horse is taken by the ox, the ass, the camel, and, sometimes, even by the elephant. In Egypt and neighboring countries the camel is frequently used for ploughing, and in India, Siam, and Burmah the elephant is sometimes used for the same purpose. In Egypt a camel and an ox hitched to the same rude plough is not an uncommon sight.

In farming the horse draws the plough which breaks the ground, and later pulls the harrow to pulverize it. It draws the machine which sows the seed, and pulls the reaping-machine. The first threshing-machines were operated by horse-power. The steam thresher has superseded the horse-machine through America and Europe, and in the large farms of America the plough, harrow, cultivator, and reaper are frequently run by steam instead of by horses. In mining, in all countries where steam or electricity is

not used, the horse and the donkey play important parts. They draw the ore-laden cars from the mine; they work the pumps which lift the water from the depths of the mine; and, in Mexico and South America, in what is known as the "patio" process of extracting precious metals from the ore, horses and donkeys trample the crushed ore, mixed with quicksilver and other materials, on a paved court, or patio, to mix the ingredients together.

The horse, the ox, or the donkey walks round and round, fastened to the end of a long beam or sweep, working the rollers which crush sugar-cane in primitive mills, raising water from deep wells, mixing clay in brick-yards, crushing ore in mines; but these uses are now becoming rare in civilized countries where the machinery is now driven by steam or electricity, or sometimes, by direct water-power. In India, China, the Philippines, and other lands, even in Mexico and South America, the grain is still threshed from the husks as it was done thousands of years ago, by animals. A space of ground, called the threshing-floor, is pounded down until it is as hard as possible; the grain is then spread out on it, and horses, asses, or, more frequently, oxen or carabaos, are driven over it, around and around, until their hoofs tread out the kernels from the chaff. The earliest written and pictured records show that this method has been used from time immemorial, and in the Old Testament is laid down the rule: "Thou shalt not muzzle the ox that treadeth out the corn." After being threshed out by the feet of the cattle, the chaff is winnowed from the grain by throwing the mixture into the air, or shaking it in flat baskets, when the wind carries away the light chaff and leaves the heavier grain.

IN MANY OCCUPATIONS.

The domestic animals are useful to man in many ways besides transportation, travel, and agriculture.

The shepherd would be at a sad loss without his sheep-dog, which displays at times a wonderful intelligence. The shepherd-dogs of Scotland and Northern England guard the flocks of sheep, gather them when scattered, even on the darkest night, find them in a snowstorm, drive them to the fold or to market, and display almost human intelligence in performing their duty. Dogs assist in herding and driving cattle, and it is said that the bull-dog used to be used to help herd the half-wild cattle of England; that it would seize the muzzle of the half-wild cow or bull that chanced to attack his master, being trained to do so, and that he came to be used in the cruel sport of bull-baiting, and thus got his name.

In old days, when cooking was done at big, open fires, meat used to be roasted by being placed on a long spit, a metal rod thrust through the meat. This bar or spit had to be turned so that the meat would not burn but would be equally exposed to the heat on all sides. Sometimes the spit was turned by hand, but many of them were turned by means of a small treadmill at one end, and a peculiar breed of short-legged, compact-bodied dogs was developed, used to work the treadmill, and were called from their occupation "turnspits." This breed has now almost become extinct, for the use of the spit in cooking has long since passed away.

The great, shaggy dogs attached to the hospice of St. Bernard, in the Alps, have long been famous for their work in finding travelers lost in the mountain snows. They were sent out from the hospice in pairs, one dog carrying a blanket on its back, the other with a small keg of spirits. When they found a lost, half-frozen traveler he could wrap himself in the blanket, revive himself with a draught of the spirits, and so reach shelter. If the traveler was unconscious the dogs summoned the monks to their aid by barking. With the building of tunnels and railways through the

mountains and the consequent decrease of foot-travel over the passes, there is no longer so much need as formerly for these noble animals.

In Holland, Belgium, and Flanders, dogs are used to draw small wagons laden with all varieties of produce and wares. The milk-seller, in her snowy cap, clicking sabots, and with her everlasting knitting, follows her little wagon, drawn by one or two large, mastiff like dogs, the wagon containing the burnished milk-cans of brass or copper, polished until they sparkle in the sun. The vegetable dealer makes his round with his dog-team, with a load of potatoes, carrots and cabbages; and, in fact, the dogs are made to take the place of horses as far as possible.

By both Greeks and Romans dogs were employed in the chase and in war, and for the latter purpose they were armed with spiked collars, and sometimes even with a coat of mail. Ancient Corinth was said to have been saved by fifty war-dogs which attacked an enemy that had landed while the garrison slept, and which fought until all had been killed but one, which succeeded in arousing the garrison. Shakespeare was not using a mere figure of speech when, in the play of "Julius Cæsar" he makes Antony say, "Cry havoc, and let slip the dogs of war." The blood-hound was used in former times to track enemies, escaped prisoners and slaves, its sense of smell being developed to a wonderful extent. They are often used nowadays by the police authorities in tracking down the perpetrator of a theft or other crime. In Paris and some other European cities the police maintain a regular corps of dog helpers, which are trained to track and attack criminals, to save persons from drowning, to help the police patrol the city, and to do other things, being most carefully trained. In the armies of several European nations, England, France, Germany, and others, dogs are trained to go out over a battlefield after a battle to search for the wounded

who may have been missed by the Red Cross service and by the search-parties of soldiers. These dogs have, as yet, been put to no actual test in war, but promise to be very useful should necessity arise.

For pleasure there are the dogs of the hunt and of the chase, the English fox-hound, the stag-hound, the Russian wolf-hound; there are the familiar pointers and setters, used in shooting; there are retrievers, otter-hounds and beagles. Dogs are trained to fetch and carry, to be playfellows and companions by day, and guardians of the house by night.

SOME ODD CARRIERS.

In Thibet the natives domesticate the shaggy yak to serve as a beast of burden, and to draw the plough. Even their little sheep are used to carry small bags of borax on their backs from the borax-fields of the snowy Himalayas. Efforts have been made to tame the zebra and the quagga of South Africa, but these are so wild and dangerous as to be practically untameable. In Canada an occasional moose has been tamed, when caught young, and trained to draw a sledge, but this, like the use of ostriches to haul light carts or to carry a rider, as sometimes seen in travelling circuses, is more of a curiosity than a practical good.

CHAPTER XXVIII.

Hunters, Messengers, etc.



WE have considered many ways in which animals make us more comfortable, serve as food, give us clothing and so on, carry us from place to place, or move machines. In all these, the animals' intelligence is not much called upon, excepting as beasts of burden.

But there is a kind of work and service in which the animal is a sort of comrade and assistant, in which it uses its own brain in mankind's service; and of this work the best example is thought to be the earliest of all—the service rendered by dogs in hunting.

THE DOG AND THE HUNTER.

It may be that dogs were first domesticated by the early men as food-animals; but, if so, no doubt the dog soon became a pet, kept alive because it showed fondness for its master and his family. One can understand how a young puppy became at first a plaything for children, then a companion in their sports, and so was found to be useful in finding animals or birds.

Dogs have a keen sense of smell, and would often be able to seek out small animals that lay hidden from their masters, or to give warning when the larger animals were scented. It would not be long before savage hunters would learn the value of the dog, either in seeking out prey, or in giving the alarm when danger threatened. The hunter, therefore, found he could hunt better, and be safer when his dog—keen and watchful—ran before him and searched here, there and everywhere for other animals.

Dogs are very courageous, too, and so prove useful not only in finding prey, but in capturing it. They help to delay fleeing animals by attacking them, and forcing them to turn and defend themselves. This gives the slower hunter time to overtake them. Even the largest and fiercest creatures, when attacked by a pack of hounds must fight them since they charge one or two at a time from whichever side is safest for them. Dogs inherit this way of fighting from their wolf-like ancestors, which were accustomed to hunt in packs, and by working together were able to overcome creatures many times their size. Not only the wolves, but several kinds of wild dogs, such as the dingoes of Australia, hunt thus in great packs.

One or two men, armed even with spears, and aided by a few hunting-dogs that annoy a big animal and keep him from charging the hunters, will thus slay a big bear or other fierce creature they would hardly dare face alone. Esquimos kill polar-bears in this way.

Smaller animals that are not thus driven to bay, are often "treed," and kept from descending until the hunter comes with bow and arrows or guns; others, like foxes, are forced to enter their burrows from which they may be dug out when the hunter is attracted by his dogs barking.

WHY DOGS BARK.

Since the wild animals that are most like dogs never bark, their only voices being snarls, howls and the like, it is believed that the barking of the domesticated dog has come from an attempt to "speak"—that is, to imitate the voices of mankind. If this be true, the barking must have been learned ages ago, for even the tiniest puppies will bark almost as soon as their eyes open.

Dogs still howl and yelp, but their barking is used to give an alarm, as if to call their masters. And this barking has made them most valuable as watchers.

Travelers in wild countries tell us that it is impossible to come near a native village or camp without causing the many dogs to give warning by loud barking—and this must have prevented many a tribe from being surprised by their enemies in night attacks, or from being led into a hidden ambush. Certain it is that nearly all wild people keep troops of dogs as hunters or watchers.

THE TRAINING OF HUNTING DOGS.

Having learned the value of dogs in the chase, men soon began to make them more useful by training them how to act when seeking different kinds of birds or animals. Some dogs were taught simply to track the animals, and to bark or bay so the hunters can follow. Others were taught to attack in packs, and to pull an animal down. Bird-dogs have learned either to advance very silently and carefully, and then to stand motionless with nose pointing out the crouching birds, like the “pointer,” to crouch down, and then to scare up the birds when told to advance, like the “setter,” or to pick up the bird after it has been slain, like the “retriever,” and so on.

Each kind of animal is hunted in the best way, and the clever dogs soon learn whether to trail it, to pursue and kill, or simply to keep the animal engaged until the master comes. And thus we have deer-hounds, or fox-hounds, the bull-dogs (formerly taught to “pin” a bull by the nose, and hold on), bird-dogs, the swift greyhound, the slow and sure dachshunde, and so on in endless variety, even to the dogs taught to find the vegetable growth known as “truffles.”

Pet dogs, too, have been bred in such differing shapes that it is hard to believe the tiny fluffy poodles and the enormous Great Danes can be at all related.

THE SHEPHERD'S DOGS.

For a dog that shows intelligence of its own, the Collie may well be put first of all. The Scotch shep-

herds have trained these helpers until they seem scarcely to need the master's word of direction. They guard and guide the sheep, drive them, keep them together or pursue stragglers, convoy them along paths or across bridges in safety, and even seem to know individual sheep. And the sheep obey their dog-masters—or may be punished by a sharp nip or a tug at the woolly fleece when they go wrong or are stubborn.

The collie is at its best when doing this work, becoming intelligent, alert, and interesting. Recently collies have been trained or bred as family dogs and pets; and this may soon cause them to lose something of their bright intelligence, though the beauty of their shapes may be improved, and their furry coats be more attractive.

OTHER DOGS THAT EARN THEIR LIVING.

Those that draw sledges and carts have been told of, but we must not fail to mention the St. Bernards that are taught to find lost travelers in the snowy passes of the Alps, carrying food and drink at their collars; and the Newfoundlands—those strong swimmers that rescue the drowning; and the dog-scouts trained to carry messages and packages for soldiers. Of late, dogs have been trained as police—being taught to follow and to drag down criminals, keeping them until their masters come to make the arrest, and then if necessary to help in subduing wrongdoers.

All these duties require dogs to be not only of great intelligence, but to be carefully trained, and there is little doubt that of all animals, dogs have become the cleverest and most useful.

VARIOUS ANIMALS THAT HELP IN HUNTING.

Lions, tigers, the chita, and other animals of the cat kind (*felidæ*) have been taught to assist in hunting, but the dog is so much superior to them all, and so

more capable of doing the work that other sorts of animals are seldom chosen, especially as they are not so easily tamed or controlled. For catching rats and mice and such small creatures, cats and ferrets are most useful, but they are likely to remain wild or to give up the pursuit of game if they can live without it, while dogs will hunt for the pleasure of catching the game.

To catch other birds, the hawks and falcons were formerly so much used that the art of "Falconry" was one of the favorite pursuits in old times. It had its own literature and its own complicated customs. To each rank in life was allotted a special species of hawk, and many terms of falconry have entered into the English language—being found frequently in Shakespeare's works, for example. Hawks were highly valued and greatly petted, a special place being set apart for them in the great castles, and a number of men being employed to train and care for the birds.

Not only other birds, but hares and rabbits or even small antelopes were taken by means of the fierce hawks, and it was for many years not only a pursuit but a passion with the great lords and ladies. Today the sport is hardly practised except in the less civilized countries of the East, though some attempts have been made now and again to revive the exciting pastime.

Among the Chinese, fish are often caught by the aid of the cormorant—a bird that may be regarded as a creature resembling both hawk and gull. Left to itself the cormorant would at once swallow the fish it has caught from the sea; but a ring is put around the bird's neck, and so the fish can not be eaten.

THE CARRIER PIGEON.

Besides the hawks and cormorants, the pigeon must be named among useful birds, for its "homing instinct" has caused it to be employed since earliest

times for the carrying of messages. By carrying one or more of the "carrier pigeons" in a cage or basket, the traveler, the sailor, the general or merchant was always able to communicate with the place from which the birds had been taken.

The message being written on a small piece of very thin paper was rolled up tightly and then inserted in a bit of quill—a light water-tight tube that could be tied either to the bird's leg or to the root of the wing close to its body. Then the bird, being released, would mount high into the air, and after circling about several times would choose its route and dash away for its home—nearly as quickly as an express train. The pigeons flew thus enormous distances, carrying the messages rapidly and safely unless at times the unfortunate birds were caught by a hawk or met with some other disaster.

News dispatches, letters, appeals for help, word of wrecks—every kind of message was sent by these little mail-carriers, whose usefulness has not even yet entirely ceased, though the telegraph, telephone, and the wireless forms of both have largely taken their places.

In 1870, when Paris was cut off from the outer world by the German armies, the only word that could be sent out was carried by pigeons, or by a few rather unsuccessful balloons. The pigeon-mail was most effective. By the use of cameras, messages were photographed in such a small scale that thousands of words could be sent on a tiny roll of thin, tough paper, and then, by enlarging the messages by other cameras outside, they became readable. In this way a single carrier-pigeon could carry what was equivalent to the contents of a heavy mail-bag.

Now that the wireless messages can be so easily sent in all directions at once, it is unlikely carrier-pigeons will ever be so necessary, unless some means of interrupting the wireless dispatches is found.

SOME DOUBTFUL INSTANCES.

We have now mentioned the more important cases in which animals are helpful to us in other capacities than as food, as carriers of goods and travelers, and as movers of machines. But there still remain a few ways that are not so easy to put into classes.

Of these the Elephant, as employed in India, may be taken as an example. Not only are they beasts of burden, carrying both persons and every sort of merchandise, but they are elaborately decorated and used to give dignity to rulers or add pomp to the great ceremonies. They also have been used in warfare since before the days of Alexander the Great, against whose army they were driven, bearing on their backs great square boxes—known as “howdahs”—in which were archers and spearmen to rain missiles upon the enemy. The elephants themselves were trained to fight with tusks and trunk, or to trample upon the soldiers who attacked them.

War-horses also, in many instances, were taught to bite or to strike at the enemy with their hoofs, and so, with the elephants, might be regarded as soldiers or helpers in warfare. Monkeys, we are told, can be induced to throw down coconuts when pelted with stones, and thus serve the men who are saved from the difficult climb up the long trunks of the palm-trees. Pigs have been taught by the French to root up truffles from the ground, and there are other instances where animals are, through the cleverness of men, made to aid in some useful employment.

But these cases show rather how men can take advantage of the natural traits of other creatures, than how these animals lend their services to make human work easier, and it may be doubted whether man has found any real helper except the dog and possibly the horse.

The dog really seems glad to join in some of his master's work, and to become a true comrade and par-

taker in his occupations. The horse, also, shows affection and comradeship, even if he has not the dog's intelligence and loyalty. On the contrary, cats, hawks, ferrets, the cormorants, together with the creatures that are allowed to hunt vermin about men's homes—such as the mongoos, some lizards, and harmless snakes—are really entirely selfish, and would pursue their prey quite as readily in a wild state, and without man's encouragement.

Therefore the list of true "helpers" among animals is an exceedingly short one, since so few creatures are intelligent enough to understand what service means.

CHAPTER XXIX.

Animals in Sport and Animals as Pets.

IN the very early ages of the world, man hunted animals for food alone. Animals hunted man for the same reason. So it is easy to see how man speedily grew to consider his relations with the wild animals which he hunted, and which hunted him, as a continual contest, a strife, a battle.

When civilization had advanced to the point where grains and fruits formed a part of man's food, the necessity to hunt animals for meat was less apparent. But the habits of centuries were well formed, and hunting animals became an amusement, as well as a means of livelihood. From this it was but a step to the arena of ancient Rome, where gladiators fought with savage bulls, with lions, with tigers, and other ferocious beasts. Rome, too, enjoyed the old Egyptian amusement of racing, and made the chariot race popular; perhaps it was not the less attractive to a cruel people that the tiny car and the three wild horses, held so many elements of danger.

These two ideas, fighting and racing animals for amusement, have come down to our own day, although in modified forms. In Spain and some of the Spanish American countries, notably Mexico, the arena of ancient Rome has been changed into the bull ring, where bull fights, the national Spanish amusement, take place. To American eyes, the spectacle is somewhat bloodthirsty, because it means the killing of one or more bulls, the almost certain injury to many horses, and the possibility of severe injury to the human actors; but to the Spaniards and the Spanish races,

the bull fight is as much a sport as baseball and football are to us.

THE CRUELTY AND DANGER OF THE BULL FIGHT.

The bull fight takes place in a ring or arena called the *Plaza del Toros*. A bull, made as savage as possible by denial of food and water for a time, is allowed to enter the ring, which has a sandy floor, to prevent slipping, and to permit the easy covering up of blood stains. He is attacked or baited by horsemen, armed with lances, called Picadors, whose duty it is to infuriate the bull by pricking him with their spears, to hurt without injuring him. The short, sharp rushes of the bull are avoided with wonderful skill by the horsemen, whose very lives depend upon their quickness and ability as riders, but it often happens that the bull is too quick for them, and succeeds in goring a horse. In such a case, the dismounted Picador runs for his life, and scales the wall of the arena as quickly as he can, to the jeers of the watching crowd. When the bull has been tormented into such a state of rage that he will charge at anything he sees, men called Banderillos, come upon the scene. They are armed with darts which bear flags, flowers, and in some cases fireworks. The Banderillos are on foot, and their task is to plant two darts directly behind the shoulders of the maddened bull, and then escape without a scratch. This they do by allowing the bull to charge them, stepping nimbly to one side, and thrusting in their darts as he goes by. This they are enabled to do because the bull, with his head down, can not see where he is going, but rushes blindly along, only to turn, surprised and angry, that what he thought to toss on his short and powerful horns, has escaped him.

Naturally, the bull goes frantic with rage and pain from the burning of the fireworks, the sting of the pointed darts, the smell of blood, and the noise of the cheering crowd, all helping to madden him. When he is quite insane with anger, the Matador, dressed in

black, and armed only with a sword, comes upon the scene. The bull fight proper then takes place, the bull endeavoring to kill the man, the man coolly sidestepping his rushes, and pricking and still further tormenting him as he goes by. When the Matador has demonstrated his quickness of foot to the satisfaction of the crowd, he prepares to kill the bull, which he must do with a single thrust of his sword reaching the bull's heart. On the expertness with which he accomplishes this feat depends his reputation. Skillful Matadors become the idols of Spanish crowds, even as the much more skillful baseball players are lauded by the American public. It is no unusual sight to see the successful Matador pelted with flowers, money and jewelry after a fight. But a Matador's reputation is hard to win and easy to lose; let him make a misstep, and have to run from the bull, let him be chased from the arena by the angry animal, and it is the bull which becomes the popular idol of the moment, the people crying, "Brava, El Toro!" and the Matador is held up to scorn.

CHANTICLEER IN THE COCK PIT.

Cock-fighting, a very ancient sport, was brought by the Romans to England, whence it spread to America and to the Spanish countries. The cock is among the "gamest" of the lower orders of life, always willing to fight and continue fighting as long as strength remains. But man, not content with watching two cocks fight with nature's weapons, has provided them with special steel fighting tools, called gaffs, or spurs. The natural "spur" on a cock's leg is cut off, leaving only a small stump, and the steel gaff or spur, ending in a cup, fits over this stump and is bound into place. A stroke with this sharp pointed spur, which differs in length, though usually about one and one half inches long, is very speedily fatal to the opposing bird; a good, strong, downward blow drives it deep into his body.

Cock fights are conducted in a cock pit—an inclosure from ten to fifteen feet across, and either round or square. It is surrounded with a little fence or rail about eighteen inches high, and provided with a sandy or earthen floor. The cocks, trained by special feeding and exercise for weeks beforehand, are introduced into the ring, held together for an instant, and then released. Generally they begin to fight immediately and continue until one or the other runs away or incapacitated, falls helpless. The bird who is beaten is then “counted out,” that is, the umpire commences to count aloud,—“one, two three, etc., up to thirty; if the bird “taking the count” shows signs of wanting to fight again, or gets upon his feet, before “thirty” is spoken, the “count is broken,” and the fight proceeds.

Cocks are bred for fighting purposes, as race horses are bred for speed, and although the sport is under the ban of the law in many States in the Union, because it has been found to bring about fights, gambling, and other evils, it still flourishes in secret in many places, particularly among the negroes of the South.

CRICKET FIGHTING IN CHINA AND GERMANY.

The cricket can hardly be regarded as an animal, but it deserves a moment's notice here, because the cricket, too, is pugnacious in the extreme, and in both Germany and China, cricket fighting is a common diversion. Two crickets are placed in a small enclosure and allowed to fight each other, which they do by butting and kicking each other, until one or the other, with a tremendous jump, leaps from the “ring” and is considered the defeated party. The “sport,” if such it can be called, however, while amusing, is rather tame, and rouses no such popular enthusiasm as that induced by other animal contests.

THE SPEED OF MAN'S BEST FRIEND—THE HORSE.

Horse racing has always been a popular sport, and in itself is a clean and interesting sight. It is the evils

of gambling that have been the curse of the race track. They so injured the sport that, in this country, many States have passed laws which forbid horse racing if betting is permitted. But the sport itself has nothing in it of cruelty or danger, as have those just described, and the continual endeavor through centuries of horse training, have evolved a type of animal which is "game" to the core, and able to get over the ground at most remarkable speeds. Of course, accidents sometimes happen in a horse race, when a horse misses his footing and falls, but accidents happen in any sport. Horse racing has always been of particular interest to royalty, the kings of England especially having been enthusiastic "patrons of the turf."

The intelligence of the horse has been one of his chief assets in sport; he so easily grasps the idea of a contest, and his great heart swells so with determination not to be beaten when he is racing that it is not an unknown thing for one to kill himself in the endeavor to win, literally breaking his heart with the strain. But a well-trained and properly prepared horse can not do this, no matter how hard he tries to win.

It is the intelligence of the horse, too, which has made him a favorite pet, even if his principal uses have been in racing or in drawing a load. And horses have very decided characters. "Black Beauty" is but a type; it is easy to see that an animal with the capacity for absorbing knowledge, and the ability to love which is possessed by the horse, must be more or less influenced by its treatment. Thus, a horse which is considered "vicious, scary and unreliable," has in all probability been mistreated, and, if not too old, wonders may be worked with him by a competent trainer who will make him realize that his days of beating and of ill treatment are over.

It is not difficult to train a horse to do tricks, if patience and knowledge unite in the task. He can be made to perform some really startling feats, such as

writing his name by picking out the blocks bearing the proper letters, and arranging them, playing a tune by pulling various bells with his teeth, and doing various kinds of waltzes and dance steps. Of course in these tricks the horse really obeys the signals of his trainer. At least one horse now performing has been taught the "two step" and has learned the still harder lesson of keeping time to the music, instead of requiring the music to keep time to him, as is often the case with half trained animals.

THE INTELLIGENCE OF THE COW-PONY.

Soldiers, cowboys, and others whose lives often depend upon their mounts, and upon their ability and willingness to mind, not infrequently train the animals to quite an uncanny degree of intelligence. The cow-pony must know when to stand still, and when to back away, and after a cow is "roped," must be able to back, and keep the rope taut, even while the rider dismounts and "hog-ties" the fallen cow, and certainly no cow-pony who wouldn't stand perfectly still all day long if his bridle were hanging straight down from his head, would be considered for an instant as well trained.

THE JOLLY LITTLE POLO PONIES.

In the game of Polo, played on horseback, the polo ponies often seem to play the game as much as their masters, and will "block off" an opposing rider, "follow the ball," and make quick stops and sudden turns at the word of command without their riders, whose hands are busy with the long handled polo mallets, ever touching the bridle. Rudyard Kipling's story of the "Maltese Cat," a famous Indian polo pony, is based on this ability of the animal to learn to play the game.

THE MANY VIRTUES OF BOSSY.

Cows are rather unsatisfactory as pets. Their intelligence is of so placid and limited a character, that "bovine intelligence" is a recognized term of con-



FINCHES.—1. Lapland Longspur; 2. Bulfinch; 3. European Greenfinch; 4. Meadow Bunting; 5. Cardinal; 6. Rose-breasted Grosbeak; 7. White-throated Sparrow.

tempt. Yet cows show a certain amount of affection for those who feed them, and in the case of certain highly bred animals, a placidity of character and evenness of temper which are admirable if not always desirable. Say of any one, "She has a cow-like character," and one at once thinks of a placid, brainless, temperless, colorless individual.

The cow, however, has virtues of her own, and if she is not easily trained as a pet, she never thinks of being disobedient, but comes and goes at the word of command with quite exemplary docility. She is a most devoted mother to her young, and will cry pitifully for days if deprived of her calf. One sure way to the affection of "bossy" is a liberal supply of coarse salt, which cows seem to regard very much as children love candy, or as cats love catnip.

THE CANARY AND OTHER SONGSTERS.

Birds make fine pets, because most of them give to their owners a full return for the care bestowed upon them, either in affection, in song, in speech or in tricks. Of all caged birds, the canary is most popular. It is an inexpensive bird to buy, and requires the minimum of care. But all birds which live in cages require a certain amount of care, absolute cleanliness of cage, proper bathing and drinking water, and sufficient attention to the kind and quantity of food to prevent overfeeding, indigestion, and other bird ills.

Nor can all caged birds be treated alike—some parrots, for instance, have to be taught to drink water. In the tropical countries from which parrots come, they get their water in moist food, and if allowed all the water they want, when caged, will, before being trained to water, drink themselves to death. It is impossible here to give detailed instructions for the feeding and care of all the many varieties of pet birds, but such instructions can be easily obtained from bird-fanciers, and should be strictly observed.

Besides the ordinary yellow canary of the Hartz

Mountains, the South Andreasburg Warblers are the most popular and well known; and these sweet little singers will chirp and warble away, perfectly happy for their often long lives, if their cages are of the right size, with proper perches and properly fitted with food, water, and shell.

You can easily improve the song of your canary, if he is young enough when you begin to train him, by hanging him in a cage protected with thin muslin or other fine, thin cloth, in a quiet room, where several times a day, you play some simple air on the piano, flute or violin. The same air should always be played. Having the cage covered prevents the canary's attention from being distracted, and having the room quiet prevents him from trying to reproduce other sounds. With care and attention, a good canary can be trained to sing many different notes. Still another way to train a canary to sing is to put him in a room with other singing birds, and let him learn to sing by imitation.

Mocking-birds and nightingales both have sweet songs, but both are more trouble than canaries and require larger cages and more care. Many birds combine not only beauty of song, but beauty of plumage, as, for instance, the Cardinal (grosbeak), a brilliant red and black bird, sometimes called the Virginia red bird or Virginia nightingale. His song is more a whistle than a singing note, but it is very pure and pleasing, sometimes like a flageolet.

THE PARROT AND HIS NEAR RELATIVES.

Hardly to be considered as sweet singers, although they do sing at times, are the parrots. But they make up in beauty of plumage and in the interest of their conversation for what they lack in sweetness. Parrots are of many varieties, and some talk much better than others, but it may be said without fear of contradiction that many parrots who could talk fail to do so



PARROTS, PARRAKEETS AND MACAWS.—1. Purple-Capped Lory. 2. Leadbetter's Cockatoo. 3. Red and Blue Macaw. 4. Ring-Necked Parrakeet. 5. Kakapo. 6. Blue-Crowned Hanging Parrot. 7. Rosy-Faced Love-Bird. 8. Common Gray Talking Parrot. 9. Rosella Parrakeet. 10. Grass Parrakeet, or Budgerigar.

because of improper treatment. A parrot talks by imitating what he hears, not by learning the meaning of words. Undoubtedly he does understand, after a while, that certain sounds he makes will produce certain results; as, for instance, that "Polly wants a cracker, give Polly something to eat," brings food oftener than some such sentence as "Polly is very angry with you—go away!" But he learns first entirely by imitation. And as at best, his intelligence is that of a bird and not that of a human being, he should not be asked to learn too much at once. To teach a young parrot to talk, he should be kept in a room where there is some conversation, but where there are not too many talkers. Hanging a parrot on a perch on the street before he learns to speak is to make him a "screamer," since he tries to imitate everything at once. Saying over a few selected words and sentences to him, repeatedly, always quietly, always in the same tone of voice, will often produce results in an astonishingly short time, and no one who has not owned a talking parrot can imagine the amount of pleasure to be had from them. Some parrots live to a great age, and learn to say so many things that they can talk for an hour without repeating themselves, although this is, of course, rare.

Parrots are "rated" by bird fanciers according to their intelligence, ability to learn to talk, to sing, to whistle, their beauty of plumage, and their tameness. The grey parrot heads the list, in everything but singing, closely followed by the Mexican parrot, who sings well but whistles ill, and is not quite so good a speaker. Then, in the order of their merit, all points considered, come the Carthagenas, Single Head, Amazon, Blue Front, Maracaibo, Cuban, Dwarf, and the Macaw and Cockatoo. The Macaw is one of the most brilliant birds imaginable as to plumage, but is far behind his less dressy brothers and sisters when it comes to intelligence and speech. As for the Cock-

atoo, he neither sings nor whistles, but he is very saucy looking!

Mention should be made of the East India Mino, a handsome, affectionate bird, not very well known in this country, which has powers of speech equal to the best grey parrots, and a wonderful ability to imitate the human voice.

Any list of pet birds would be incomplete which left out the Bullfinch, which, songless naturally, can imitate almost any other bird, and many musical instruments. They are trained largely in Germany, and add to their sweet, flutelike tones most engaging manners, bowing and scraping, "fanning" their broad tail, and generally performing clever antics, which make them favorites among bird-lovers for household pets.

Still another bird which makes a capital household friend is the Troopial, from South America and Mexico, a handsome bird of orange and black coloring, with white tips to his wings. He is friendly and affectionate, and has a sweet though not powerful song. He has good powers of imitation, and can be trained as canaries are trained, by having simple airs played to him on the piano. The old idea that the parrot's powers of conversation are increased by cutting or slitting its tongue, has been largely given up by bird-fanciers, so that this cruel operation is not necessary to make your bird a talker.

THE DOG'S CAPACITY FOR LOVE AND DEVOTION.

Great men of all ages have loved animals, and many four-footed companions have been subjects for song and story. It is said of Sir Walter Scott, whose famous dog, Maida, is so well known, that he would not go riding or driving on Sunday, because he believed the rest day should be one for animals as well as human beings. One can hardly believe his horses understood their day of idleness, but it is safe to say they enjoyed it!

“He prayeth well who loveth well
Both man and bird and beast”

applies to all the animal kingdom, but seems particularly appropriate to dogs. Perhaps a general vote of the whole world would declare the dog the best and most popular pet, as he is certainly the oldest. This “friend of man” dates so far back as a companion that we don’t at all know just when he was first tamed. And besides his great heart, which has a capacity for love and devotion equalled by no other animal, his ready intelligence is so large, he is so prompt and quick to learn, that the love of mankind for this, our principal four-footed companion, is easily understood. Of course, there are dogs and dogs. The real dog-lover does not consider the “toy dog” of the lady of fashion as truly a dog, but merely as an animal. Many of these tiny little beasts have a great deal of intelligence, but for the real exhibition of doggish brain, one has to turn to the Collie, the St. Bernard, the Spaniel, Setter, Pointer, the Poodle, and the various terriers. It is often said, however, that the mongrel, or dog of mixed breed, may be as clever or cleverer than those of pure breed.

THE INTELLIGENCE AND BRAVERY OF DOGS.

The St. Bernard dogs are those beautiful, huge beasts whose exploits you have read about in stories—the dogs that go forth in search of travelers lost in the Alpine snows, find them by an unerring instinct or a very delicate sense of smell, and drag them to the shelter or return to the Hospice of St. Bernard, or guide helpers to their assistance. There have been many of these St. Bernard dogs with long and beautiful records of lives saved—one, “old Barry,” rescued forty-two men from certain death in the Alps, as truly as a hero and as worthy of a medal as any man who ever risked his life for others.

The Collie is the shepherd dog of Scotland, per-

haps the most intelligent of all dogs, certainly one of the most affectionate, and one of the most jealous. Perhaps you have read the beautiful dog story, "Bob, Son of Battle," in which case you know what wonderful knowledge these dogs acquire. In Scotland they drive sheep with the same intelligence a man would give to the task, hurrying in the stragglers, keeping the flock together, guiding it in the right direction, and even, so it is said, counting the sheep as they go in the pen at night and darting away to look for the stragglers, if any be missing!

HOW DOGS RESPOND TO KINDNESS.

Sheep dogs are trained carefully, and you may be sure, kindly. The collie is particularly sensitive to a blow, while very responsive to kindness. In training a collie for sheep work, he soon learns to watch the trainer's hands, since his first lesson is running after meat, thrown by the trainer. He is thus speedily taught to go where the hand motions him, whether there be meat thrown or not. He is taught to go slowly, so as not to rush the sheep, by a cord holding back on his collar, and it takes but a few pulls, and the drawling "slo-o-o-w—slo-o-o-w!" of the shepherd to show him that the words and the pull mean the same thing.

"Fetch 'em up—head away—get out wide—slow—slow—hold" are all commands for the sheep-tending collie which a well trained dog understands as well as his master.

Dogs of all kinds are extremely teachable; they can be made to understand words and signals, and very different from many other animals, take a positive delight in being taught, and in doing their tricks. It is never necessary to use anything but kindness and firmness with a well-bred dog; the whip is an unneeded tool for the dog trainer. Any dog who has learned to love you will be as sorry and as ashamed after a



A Beautiful St. Bernard, whose Money Value to his Owner is Several Thousand Dollars.

few sharp words of scolding for having done wrong, or having made a mistake, as you could make him with a whip, and there is surely nothing more pitiful nor more unpleasant to watch, than a dog trained for public shows going through his little performance with his tail between his legs, shrinking from his master because he fears pain if he does not do well! How different the performance of the dog who has been trained with love and kindness only; he bounds through his tricks, barking with pleasure, and when he has finished, and gets the reward of a pat on the head and "Good boy! Good dog!" from his master, leaps from the ground in a vain endeavor to get at that good master and lick his face!

NOT DIFFICULT TO TEACH HIM A TRICK.

It is sometimes necessary to use a gentle force in training a dog, but there need be no thought of pain or punishment in it. For instance, to train a dog suddenly to fall down and "play dead" at the word of command, it is customary to tie a cord to his forepaw. When giving the command, "Dead, sir!" the cord is pulled and the dog falls over. He is astonished, but not hurt. And up he jumps. But in a short time he begins to understand that that funny sound, "Dead, sir!" means he must tumble down. And before you know it, he is tumbling down at the words without waiting for you to pull the cord.

A FEW RULES FOR THE DOG'S HEALTH.

Dogs should not be teased. Not only may it spoil a sweet temper, but it isn't "playing fair;" your dog loves you, and will stand a great deal more from you than you would stand from another boy or girl. And the dog can not talk and ask you why you tease him, nor tell you how much he dislikes it. He can only look at you with great brown eyes full of love and the complete unselfishness which forgets a whipping or

a cross word with the first smile. Nor should his training in tricks be too long continued at a time, and, just as you punish failure or disobedience with a sharp word, never forget to give the kind word, the pat on the head, the occasional bit of food, as a reward. And never, never forget to see that his cup of water is full; food he can go without or get for himself, but the boy or girl who will forget that cup full of water for the dog who can not ask for it, doesn't deserve to have a dog at all. Do not chide your dog for lying with his mouth open, even if it drips. It is his way of perspiring, and means nothing except that he is hot. Try to keep a dog as clean as you can, and help him clear his coat, if it is rough, from burrs and tiny twigs. If you wash him in cold weather, finish with cool water, and then dry him thoroughly; he is just as apt to catch cold from too cold or too hot a bath and a long drying, in cold weather, as you are, and particularly the sensitive dogs, such as collies, spaniels and terriers; pneumonia is specially to be guarded against by reasonable care after bathing. Spaniels, who love the water as do ducks, should not be allowed to go swimming after sticks in winter weather. Your water-spaniel is willing enough; to him, water is something to swim in; but his sensitive body must be guarded for him in cold weather, since his love of water, and wish to please you, are greater than his knowledge of what is good for him.

LOVE, LOYALTY, AND INTELLIGENCE OF DOGS.

A dog's intelligence is not limited to tricks. Stories of dogs who have saved lives, not only by hunting for and bringing help to the lost, as do the St. Bernards, or by physical prowess in dragging children from the water when in danger of drowning, but by reasoning and warning people of danger, are common enough. The terrier who arouses his master in the night by barking at a fire; the collie who wakes his master from sleep, and, by running back and forth and

barking, leads him to the sheep-pen where a wolf is killing his charges; the dog whose wonderful sense of smell and still greater sense of love and loyalty tracks down a lost child in the woods; sure such a dog has intelligence above the mere obeying of the word of command. Such a dog was "Help," the English dog who traveled on railway trains, collecting money for the orphans of railway men. His collar bore the inscription, "I am Help, the Railway Dog of England, and Traveling Agent for Orphans of Railway Men who are Killed on Duty." In three years, "Help" collected more than \$2,500, nor did he ever fail to bring his little collar-bank safely back to those who would best dispose of its contents.

CATS HAVE DIFFERENT QUALITIES FROM DOGS.

Of great age in the world of pets, too, is the cat, once a sacred animal in Egypt, and always a type of the mysterious and the unknown. Yet Pussy, as a household companion, has little mystery about her, and much that is pleasant and lovable to recommend her. To be sure, her affection for places and the things she knows is generally greater than her love for people, and as Rudyard Kipling has so well indicated in his *Just So* story of "The Cat that Walked by Himself," Puss has a great deal of independence of character, and is more given to doing what Pussy likes than what her master or mistress may desire.

Yet cats can be trained to perform tricks, although it is very doubtful if they ever enjoy doing them, as a dog undoubtedly does. And more than any other domestic animal will a cat resent being struck, so that kindness, firmness and patience are essential in training her for trick purposes. Almost any cat can be taught to jump over outstretched hands by offering her meat, and preventing her getting to it in any other manner than over the hands. In the same way and with the same bait, she can be persuaded to walk on her hind legs, and as cats have much greater control

of their bodies than almost any other animal, they find the trick of balancing, which is often so hard for a dog to learn, very easy indeed.

It is very hard to teach a cat not to steal food; they have little idea of "honor," such as many dogs seem to have, and will take good things to eat whenever and wherever they can get them. Nor should they be altogether blamed for this, because they are made in that way. The theft of your evening supper's beefsteak, while highly annoying, is not a crime, from the cat's standpoint. Yet they can be trained, by punishment and good habits, and many a well-behaved cat will eye food on the table with quite a human expression of desire, without offering to touch it. Strangely enough, cats do not seem to resent being cuffed as a *punishment* nearly as much as they do being struck when being trained to do tricks, which might indicate that, after all, Pussy does know something of the difference between right and wrong. But the cuffing should be dainty and gentle; a cat seems to have a very highly strung nervous-system, and great or sudden jars seem to affect it for long periods of time, so that a cat, struck hard two or three times, may be years forgetting the insult.

Cats are easily broken for house pets by providing them with a dirt box—naturally a very cleanly animal, they will be at much pains to be neat. Of the many varieties of cats, it can be said that the Maltese is most given to roaming and running away, and is decidedly less affectionate than the ordinary common cat; and that the Coon cats and Angoras, both long-haired and bushy-tailed animals, the latter the aristocrats of the cat world, are those most usually taken for exhibition purposes. Cats, like dogs, are carnivorous and should have some meat; but too much red meat for any tame animal means a bad temper and likelihood of fits and sickness.

See that Pussy has water always at hand, is fed with plenty of milk-soaked bread, potatoes and gravy



PATSIÉ AND CORDELLA.—To-day scientists are studying the effects of training upon Chimpanzees, the most intelligent members of the monkey family. Greatly resembling human beings, they soon learn human ways in eating, dressing, etc., but easily lapse, if left to themselves.

and some meat, teach her to respect your dinner and your house, and you may, some day, sorrowfully, yet with loving memory, write for your departed cat what the poet Whittier did for his pet, Bathsheba, as an epitaph:

“Whereat
None said ‘Scat!’
Better Cat
Never Sat
On a mat
Or caught a rat
Than this cat.
Requiescat!’”

MONKEYS ARE INTERESTING, BUT MISCHIEVOUS.

Monkeys make fine companions and pets, but are a good deal of care, and as they are mischievous to a large degree, and as their hands are such perfect imitations of ours, they are able to do more damage in less time than almost any other animal used as a household pet. When you also consider that they are competent to climb anywhere, you see that there is nothing whatever safe from them, and that if you let them loose in a house, you may not be surprised if pictures and curtains are investigated and taken down, many small articles hidden away for more careful examination later, and other things, delicate and not made for monkey hands, broken or destroyed.

Certain types of monkeys are much more hardy than others in civilization. Those varieties most common as pets are the Ringtails, the Java, the Rhesus, the Pigtail, the Long-tailed Callithrix, the Mongabey, and the Marmoset monkeys. Such animals can be purchased from dealers at from five to seven dollars apiece for the Marmoset, up to thirty dollars and even more for specially fine specimens of the Mangabey and Pigtail monkeys. From twenty to twenty-five dollars will buy a healthy young monkey almost anywhere.

PET CUBS, TIGERS, AND DEER.

Wild animals, as a rule, take very badly to domestic life, and making a pet of one is often a more or less dangerous proceeding. Very young bear-cubs are often turned into pets by hunters and trappers, and, as bears prefer berries, roots, vegetables and honey to a meat diet, they seldom grow up savage. But they *do* grow up clumsy and strong, and the owner of a small pet bear-cub will come home some day to find his bear grown up, and a grown-up bear weighing half a ton, ambling clumsily around the house, hardly adds to one's comfort!

Lions and tigers have been made pets by being captured and trained when very young cubs, but the savage in them is too great to subdue, and a dangerous and unfortunate ending to such an arrangement has too often shown that it is not a wise thing to try. Rosa Bonheur, the great animal painter, had a captive tiger; but it is said that although she fed him through the bars of his cage, and was convinced of his affection for her, she never either let him loose or entered his cage.

Deer have been tamed so that they willingly eat from the hand, and some of the many wild but unsavage animals, such as squirrels, beavers, otters, ferrets, mongooses, etc., make very pleasant pets, but as they lack the generations of domestic life behind the cat and dog, one is never quite sure when they will run away!

Of course, goats, calves, lambs, colts, and ponies, are well known as children's friends and companions, but calves grow to cows, colts to horses, lambs, never very intelligent, grow to sheep, whose only ideas are salt, grass, and to be let alone. Goats make excellent haulers of small carriages, and the pet pony is an institution in this country, particularly where the beautiful little Shetland is bred and sold in large numbers. Both goats and ponies, however, require considerable care, and must be fed with great regularity, particu-



FEROCIOUS FRIENDS.—These captive monarchs here seem gentle enough; yet Denver, whose sleepy head you see on the left, and Baltimore, stretched at his ease on the right, though born in captivity, are known as “bad lions.” Baltimore once, in a savage mood, tore off the right arm of Bonavita, his trainer.

larly the ponies who can not, like cats and dogs, forage for themselves.

THE ATTRACTIONS OF THE ZOO.

Children who neglect a chance to see a great zoölogical collection, such as is found in most of the big cities, miss not only much pleasure, but also a great deal of instruction. It may be news to some that catching and shipping wild animals is a regular business, and that there are so many "Zoos," as they are called for short, that men find it profitable to keep a staff of lion, tiger and elephant hunters at work in Africa all the time, as well as men who hunt and trap the less savage animals, the deer, the monkey, the various wild-cats, bears, wolves, foxes, etc.

If you are asked which is the most interesting "Zoo" in the world, you will probably decide in favor of the one you know best. The largest "Zoo" in the United States is in Bronx Park, New York. If you have ever been in Europe, you may remember the "Sala degli Animali," or Hall of the Animals, in the great Vatican at Rome. This "Zoo" is surely unique in the world, because the animals are all stone, and some of them never lived at all! Here you can find not only sculptured lions and tigers and other strange wild animals, birds and fishes, but the fabled Chimera and a Minotaur, as well as harpies, dragons and other mythological beasts.

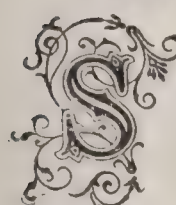
If you have an opportunity to visit a Zoo, try to go at feeding-time, for then you can see the animals excited and interested. And you will notice that each animal gets his own kind of food, and an exact and certain amount. No patients in a private hospital are cared for with a more exact science than that which directs the running of a Zoo; these rare animals, hard to get and expensive to buy, are unused to their caged life, having been transplanted from their natural habitat or place of living, and must be fed just the right

amount, at just the right time, to be kept healthy. Surgeons look after them, too, and cut nails which are too long, extract thorns from feet, fill teeth, and otherwise care for these patients as carefully as if they were human.

When you visit a Zoo, take a good look at the lions and tigers and elephants, to satisfy your curiosity. But look for the real interest of the Zoo to those cages where the rare and little known animals are kept; the kangaroo, which carries its children in a little fold of skin—like a basket or pouch against its breast; the python, which sheds its skin whole, and comes out brand-new in the spring; the yak, the strange, fringed beast of burden of Asia, as mild and inoffensive as it is savage-looking; the mild-eyed llama, the wild-eyed caracal, the soft-eyed doe, and the glittering-eyed chamois. There is much to be learned about the animals so rarely seen outside of a Zoo, even in a circus; their habits and actions are most interesting. And from them also may be learned the greatest appreciation of Kitty and Fido at home, all the more attractive by their sweet friendliness, by the soft purr, or loud bark of welcome, after you have visited their wild and savage kin.

CHAPTER XXX.

Animals, Their Tricks and Their Training.

INCE animals have not a large stock of intelligence, it is to many of us a lasting wonder that they can be taught "tricks," which they can perform in public. How are they trained in this way? How taught in such a manner that they will not forget? These are the problems which always confront the animal trainer at the commencement of his work and studies.

Many of the feats which dogs, cats and horses perform on the stage are simply explained; in counting, for example, the animal simply continues to bark or paw the ground until he receives the signal from his master to stop. Thus, the performer may say that his dog will add any three numbers given him by the audience. Three numbers are called. The performer mentally adds them; and the dog is taught to go on barking until he receives a secret signal to stop. All the dog has to learn, in such a case, therefore, is to respond to a cue given him by his master; thus he need not perform any arithmetical calculation. Many of the public feats, performed by animals on the stage, rest on this simple principle.

HOW TO TEACH YOUR DOG TRICKS.

Other tricks depend upon other principles, however. Not long ago a dog was offered in public exhibition which picked out cards, numbers, or plants as they were called for, and seemed to be possessed of almost human intelligence. This is how it was accomplished: In training the dog a small number of cards are used at first—these being gradually in-

creased as his training advances. The dog is placed upon a table, and four cards are placed in front of him. The trainer looks the dog steadily in the eyes for a few seconds, then lets his eyes fall onto a particular card. After a few trials, a clever dog will be enabled to follow his master's gaze, and, with practice, to pick out any card upon the table. This sounds complicated, but you will be surprised to find how quickly a dog will learn this when once he understands what is wanted of him.

Next, the dog must be taught to bring any object called for, when mentioned by name. To train a dog to do this, a shoe is placed on the floor, and the trainer says to the dog: "Go, get the *shoe*"—placing the accent on the word "shoe." After a number of trials, the dog will fetch it and bring it to his master. Then another object is taken—a hat, let us say. The dog is taught to bring this in a similar manner. Then the two are placed side by side on the floor, and the dog is taught to bring each one, as called for. Then a third object is added to the list, and this is carried back, at first by itself, and afterwards distinguished from the others, in the same way as the first two were learned. With patience, the dog can be taught to distinguish a number of objects in this manner, singling them out each from the other.

Next, the dog is taught to distinguish the various articles of furniture. His trainer says: "Go to the *table*; go to the *chair*," etc., after he has been shown, patiently and persistently, which each one is. These objects should not be too many at first; two or three will be plenty. The number may be slowly increased as the training progresses. After a time, the dog can go to any object in the room at the word of command.

When this state has been reached (the other part of the training not being neglected) the two may be combined. Say to the dog: "Fetch my *shoes*, and place them on the *chair*;" "Get my *hat* and place it on the *table*," etc. The key words must be said in a

loud tone of voice, to emphasize them upon the dog. All this will take many weeks, even months, of training; but when this stage has been reached, you will have one of the best trained dogs in the country.

A CLEVER TRICK WITH CARDS.

The trick part of the performance consists in teaching the dog to pick out certain cards, or plants, by observing the relative position of the performer to them. The cards being placed in a row on the table, the trainer stands in front of the row he wishes the dog to select, and the dog is taught to pick up the card in the row which is nearest his master. When this has been accomplished, two or three cards are placed in each row. A string is tied about the dog's neck, and the dog is told to pick up a certain card in the row, indicated by the position of the trainer. Naturally, the dog would pick up the first card, but if the second one is to be picked up instead, the performer stands a little further away from the table, and if the dog picks up the one too close, a slight pull is given the string around his neck until he comes to the desired card. This is done until the dog learns that there is a certain connection between the distance of the performer from the table and the card he is expected to pick up. Thus, if the performer is close up against the table, this means the first card in that row; if a little further away, the second card; and so on. By constant training and practice the dog can be made to pick out any card from a number on the table, simply by observing the position of the trainer with regard to the card—the distance from the table and position in front of the desired row. Well presented, this will never be detected even by the most observant audience.

THE SECRET OF THE CALCULATING DOG.

When this point has been reached, the dog is ready for exhibition, and the performer can make the feats his dog performs appear the more marvelous by say-

ing that the dog will add, subtract, multiply, divide, etc. Suppose the audience asks the dog to divide a hundred by four. The dog immediately advances to the cards and picks up one bearing the number 25. But the dog has not done the mental arithmetic. The trainer does this, and passes on the cue to the dog. As soon as the sum is proposed, the trainer mentally does it, and then, knowing what card contains the desired answer, assumes a position relative to that card, which at once informs the dog what card to pick up. This is the whole secret of those wonderful “calculating dogs” and other animals which are supposed to perform prodigies of mental arithmetic.

HOW BIRDS ARE TAUGHT TRICKS.

As to *bird* taming and training, the majority of them have not sufficient mentality to learn any tricks at all, though a few of them have. Most birds can be tamed, however, to some extent; and this is done in the following manner: A portion is cut from the inner plume of the pen feathers, so that the bird can not hurt itself if it attempts to leave the hand, but not enough to impair the external appearance of the wing. The nostrils of the bird are then touched with bergamot or other odorous oil, by which it is for the time so stupefied as to perch quietly on the finger or to hop from one finger to another. It may attempt to fly away once or twice, but this is not often repeated, especially if the experiment be conducted in a dark place—for example, behind a curtain, which offers the further advantage that, if the bird should fall, it is not likely to hurt itself. As soon as it sits quietly on one finger, another must be placed in such a position as to cause the bird to step upon it. As soon as it is accustomed to hop quietly from one finger to another, one main difficulty is overcome—for if, when the bird is gradually aroused from its state of stupefaction, it perceives that its teacher does not use it roughly, it

may by degrees be taught to manifest obedience to his commands.

HOW BIRDS TELL FORTUNES.

Sometimes you can see birds which are supposed to tell fortunes. They are kept by old women dressed as gypsies, and a long row of paper envelopes are in front of the cage in which the birds are confined. The bird is taken out and placed on the row of envelopes. It hops along, omitting a number of papers, and finally selects one, which it pulls out with its beak. Inside this envelope is your fortune! Why does the bird select this envelope, and skip so many? It certainly looks as if it were a special selection, but it is a trick, nevertheless.

The fact of the matter is that a seed has been glued to the back of some of the envelopes, and not to others. The bird, hopping along the row, naturally omits those which have no seed glued on the back, and selects the first one it comes to which has. This is the one which is given you, and which seems to have been carefully selected by the bird from among a lot of others. In this way your fortune is told!

Birds may be taught to ring bells, fire off pistols, raise flags, and many other novel little performances that are marvelous and seem impossible, till the method is revealed. It requires a great deal of patience and persistence.

HOW WILD ANIMALS ARE TAUGHT.

While tricks play a large part in the stage presentation of certain animals, it is doubtless true, however, that in a large number of cases, real training has to be undergone, and no trick is resorted to. Thus, in many of the larger and wilder animals, their training is very rudimentary, in comparison, since they would never have the necessary patience—like a dog—to learn all the tricks which he does. What they do is

the result of training, pure and simple. Mr. Bostock assures us that all wild animals, such as the lion and tiger, are never tamed, only trained, and that they will at once revert to their wild and ferocious habits as soon as the opportunity is offered them to do so. In order to make such animals good performers, they should be taken, when cubs, and brought up in captivity. If they are caught and brought to civilization when adults, they will rarely perform in the same complete manner as those which have been trained from their infancy. The course of training which a lion or a tiger of this character undergoes is somewhat as follows:

TRAINING A LION.

The trainer enters the cage, carrying with him a stick, which he leaves in the center of the cage, retiring to the side, apparently defenceless. Meanwhile the lion has been crouching, snarling in the corner of the cage, looking on at what is in progress. As soon as the keeper has withdrawn, the lion is upon the stick with a single bound; but finds it inert and dead and irresponsive. Enraged, the animal turns against the trainer, and springs upon him. But this time he meets with a very different reception. The trainer has carried into the cage with him a long blunt club, and, as the lion springs, this is brought down across his nose with a blow that staggers him for the instant, and sends him cringing to the far end of the cage. (The nose is the tender spot in wild animals of this character—just as the feet are the tender spots in the elephant; and advantage is taken of this fact).

By and by the lion is coaxed out of the corner of the cage he occupies, and is stroked with the very same stick which formerly struck him. Then the stick is placed in the bottom of the cage, and the lion induced to walk over it. This happens several times, until finally the lion notices, to his disgust, that the stick has been raised a little each time until he now has to make

a considerable jump to clear the stick at all. This is the procedure for the first few lessons. Then the stick can be raised, and finally a large hoop substituted for the pole or stick, and this hoop is lessened in size until finally the lion will jump through a hoop hardly larger than his own body. In this slow manner are these creatures taught to perform their tricks.

CAPTURING WILD ELEPHANTS.

Wild animals must be caught before they can be trained; and in most cases this is accomplished by means of traps, cages, etc., which imprison the animal until he can be taken away and his training begun. Elephants, however, are caught, very largely, through the assistance of tame elephants, and the manner in which this is done is one of the most interesting in the whole realm of the animal kingdom. A large corral, or inclosed space, is constructed, into which the elephants are driven; then the corral is closed. As this is very big, however, and as the elephants are exceedingly fierce, this would do little good if they could not be secured by means of ropes. Elephants, when they are caught in an enclosure, rush wildly about, trampling the brushwood beneath their ponderous tread, and charge against the palisade, screaming with rage at each unsuccessful attempt to break it down. By degrees, their efforts slacken, and in about an hour the whole horde, exhausted and stupefied, stands motionless.

The next operation is to introduce the tame elephants into the corral, to aid in securing the captives. Cautiously the bars which secure the entrance are let down, and the trained elephants, each mounted by its mahout or rider, and one attendant, enter the corral. Around the elephants' necks are strong collars, composed of ropes of cocoanut fiber, from which hang on either side cords of elk's hide, prepared with a ready noose. Gradually, each trained animal approaches one

of the wild ones, until, being sufficiently near, the nooser, watching his opportunity, slips the noose over one of its legs. Immediately the tame elephant retires with his riders, drawing the rope tight, and hauling the captive toward some large tree. In this the other tame elephants lend assistance, pushing with their heads and shoulders. The first tame one now winds the rope around the tree, and the others crowd up to the wild animal, and keep him in position while his other legs are being secured. The tame elephants in all these proceedings appear to feel a sportsman's interest, and are as eager to secure the victim as are their human assistants. Of their own accord they will perform any act which reason would naturally suggest for overcoming any difficulty that arises, or which seems necessary under any given circumstances.

When the elephant is thus secured, he is left for some time; food is placed within his reach; but this he refuses at first indignantly. After a time, however, he eats a little, and finally is induced to eat, his ropes being slackened. After this, he is led to the river between two tame elephants; and thenceforward his training is only a matter of time and patience.

THE CLEVER KANGAROO AND OTHERS.

Kangaroos are clever animals, and may be taught to box and wrestle, and a number of tricks of the sort. Seals are exceedingly clever actors—in spite of their appearance—and may be taught a number of most complicated tricks; they have a fine sense of balance, which enables them to “play ball,” and perform a number of feats of which they appear incapable. Bears, goats, hogs, mules, and many other animals may be taught a limited number of tricks, but none of them has the same intelligence as a dog or a horse.

TEACHING A FLEA NOT TO JUMP.

Fleas are trained, in a certain sense—though their capacity is very limited in extent. Their training is

divided into three eras. In the first, they are taught not to jump. This is accomplished by placing them in a glass tube, with the result that every time the flea jumps, it bangs itself against the top of the glass; and, after a few hundred such trials, the flea confines his activity to walking along the bottom of the glass vessel—and the first great lesson is learned. In the next place, the flea is “harnessed” by attaching to it a tiny gold wire, fixed around its neck and adjusted so nicely that it does not strangle the flea, and at the same time tight enough to prevent the flea from extracting its head from this minute harness. The little creature gets accustomed to this in time; and the second lesson has been learned. Finally, it is harnessed to a tiny chariot, which it pulls along as it walks, and when it has learned to do this, the third and final lesson has been learned; and the “trained” flea is ready for public exhibition.

Fishes have not enough mentality to enable them to be trained, in any ordinary sense of the word. All cases of animal training consist, for the most part, in showing the animal how a certain feat is performed, and making him perform it over and over again, in precisely the same way, until it is learned by heart. Infinite patience is the prime requisite in every animal trainer; and without it one should never try to train any animal, for it would only result disastrously for both, while little or nothing would be accomplished.

CHAPTER XXXI.

Our Friends the Birds.



WHEN we begin to think of the use of birds to man, with the idea of finding good reasons for taking care of them; for defending them from their enemies; for giving to them their true value, we are met by the difficulty that there are few of the feathered creatures who are not in some way of benefit to us. Men who are engaged in the work of studying birds, tell us that there are some thirteen thousand species, and this big figure is enough to show that it is impossible for us even to mention many of them. Only life-long students can become acquainted with them all. Luckily, it is not necessary that we should know more than a few general facts about the much larger groups into which these species can be combined.

KNOWING THEM BY FAMILIES.

The wisest men who study birds have not yet come to entire agreement as to just how they should be put into classes, and their books differ from one another in their arrangements. But since the lists they are trying to make are meant for students, we may content ourselves with learning only enough about the difference of birds to tell something about the life of a bird from its appearance.

There are a few great families, which, though they include many different kinds, yet are alike in so many ways that we can, by knowing these, be practically sure of the habits of nearly all the birds in it. It is by knowing these families that the lover of birds can tell us a great deal about even a bird that is new to

him by the merest glance at it. He may, now and then, be puzzled, but, in general, birds that belong to the same family can be told without a very close examination. In fact, nearly every one of us comes to know the commoner families about us without having paid much attention to the subject.

BIRDS WHOSE WINGS ARE LITTLE USED.

The broadest way in which men have learned to know birds is first to make a division between those that fly, and those that have practically lost the use of their wings. This is a way of dividing birds that even the youngest of us can understand, and yet it is used by scientific men. In the second group are placed the ostriches and other great birds more or less nearly related to them, that have in the course of long ages gradually lost the power of flight, and now depend for safety upon their swiftness in running. Having little use for their wing-muscles, these birds no longer have the big breast-bone which, in the flyers, is needed for the attachment of these muscles, and this difference is very plainly shown in the skeletons of the two groups of birds.

In the case of that strange sea-bird, the penguin, found in the Antarctic regions, the wings have become small flippers, useful only in swimming. That penguins were once able to fly, however, is proved by the deep keel to the breast-bone, which separates them from the order of ostrich-like birds that have lost this great projection.

BIRDS THAT ARE "SCRATCHERS."

Among the flyers, the chicken-like birds form a very large order. Although placed in this class, many of these families also make little use of their wings, especially those that have long been domesticated. These birds live in flocks, and have feet fitted for scratching in the earth. The order includes the com-

mon fowls, peacocks, pheasants, turkeys, and guinea-fowls, as well as the game-birds, grouse, partridge, and woodcock.

THE PIGEONS.

Another great group of birds that is found nearly everywhere throughout the world, is composed of the pigeons; the many domestic varieties, though differing so greatly in appearance, are descendants, it is supposed, of the wild rock dove of Europe, changing in form and habit in the course of many centuries by the selection of breeders. Some species of pigeons are noted for the wonderfully beautiful colors of their plumage. The curious bobbing motion of the head in walking is one of the marked characteristics of these birds.

BIRDS OF PREY.

Among the most useful birds to mankind are the raptors, or robbers, so called from the Latin name, *raptor*. Three great families of this order are represented by the hawk, the owl, and the vulture. They live upon flesh, and are fitted with powerful hooked beaks and strong claws to hold and tear their victims. Hawks and owls prey chiefly upon harmful insects, rats, mice, and reptiles, while vultures act as scavengers in the warm climates where they are found, and devour substances that would otherwise decay and produce disease. The good services of vultures are everywhere recognized, and in many countries they are strictly protected. In the Southern States they may be seen walking about the streets of towns and cities. Farmers are beginning to learn that hawks and owls, too, with the exception of a very few species, deserve to be protected on account of the good they do.

The eyes of owls are set in a circular disc of feathers, and both look forward, instead of being set one on each side, and the head turns so far around that

the bird can look directly backwards. In vultures, the head and more or less of the neck, is bare.

THOSE OF THE PARROT AND WOODPECKER KIND.

The parrot-like birds also form a very large order, a few of which are familiar. The name comes from the Latin name of parrot, *psittacus*, and their feet are fitted for climbing and grasping, with two toes turning forward and two backward, as in most of the woodpeckers. These birds have thick, strong, hooked bills that are used in climbing as well as in separating their food.

Another class is named from the woodpecker, and its Latin name, *picidæ*, means birds like the woodpecker, that is, having toes adapted to climbing. In some species the toes are arranged two forward and two back, in others, two turning forward and one that is reversible, or able to turn either forward or back. The character of the feet separates great numbers of birds from the perching order. Among them are the kingfishers, the goatsuckers, the swifts (some species of which have all four toes turning forward), hummingbirds, cuckoos, and, among the more uncommon forms, the brightly colored trogon and the toucan, that strange tropical bird with an enormous beak.

WADING AND SHORE-BIRDS.

These are rather loose terms applied to a great variety of birds, such as cranes, herons, ibises, plovers, rails, sandpipers, and others, found along shores and muddy flats and in nearby fields, living upon prey that are found in the mud or in the water. Most of these families have long legs, and long, slender bills.

BIRDS THAT ARE AQUATIC.

The birds we have already mentioned are known as land-birds. Among those called water-birds are the gulls and loons, albatrosses, cormorants, ducks, geese,

and swans, all of which may give us an idea of the different sorts of birds that win their living from the water. Gulls and albatrosses have wonderful powers of flight, and, as might be supposed, have very long wings. Ducks and geese have broad, flat bills, and, like most swimming birds, webbed feet. The loons are great swimmers and divers, and when pursued, usually dive instead of taking wing, as do the ducks, often remaining under water for a surprising length of time. On land loons are extremely awkward, and can hardly be said to walk at all, the legs being set far back on the body, close to the tail. The penguins, already mentioned as having become flightless, are the most "fish-like" of all birds, their wings having become paddles, while their feet are used mainly for steering. Albatrosses are strictly sea-birds, having very long pointed wings upon which they sustain themselves for long periods of time over the water.

HOW BIRDS ARE ADAPTED TO THEIR LIVES.

To make all this seem simpler, it must be remembered that the general plan of all birds has been changed in the different orders, so as to fit them for life upon the earth and amid trees; upon the sand and mud of the shores, or in shallow water; in the air above the earth; or almost entirely for swimming or diving. So, instead of trying to remember how they are divided, it is wise to understand why the different shapes fit birds to live the lives they have to lead, and to understand also where and how a bird must live if we find it to be shaped in one way or another.

BIRDS THAT PERCH.

The kinds of birds that we would consider most particularly, those we see oftenest about our homes, form a great class that are called the Perchers. These have the toes so arranged that they can easily take hold of tree-branches or twigs, that is, they have three

toes in front and one behind, the hind-toe being usually as long as the middle one, and armed with a long claw. There are more species in this class than in all the other orders combined, and it is believed that these birds are the best developed. Among them we find the brightest, liveliest, and best songsters—although ornithologists place highest in the scale the crow family, most of the members of which have no powers of song. The Latin name for perching birds, the name used all over the world, is *Passeres*, which means “sparrows,” for the Romans called the sparrow *passer*. While agreeing closely in structural character, the different species of this class are remarkably varied, especially in coloration and in form of beak. To this order belong the thrushes, flycatchers, swallows, finches, and, indeed, most of the small birds that we see.

WHY BIRDS CAN FLY.

When we examine into the structure of birds, we find that one reason they have become able to fly is their lightness. By far the greater number fly by means of flapping their wings, and these are the birds which are in every way as light as possible. A large part of their bones are hollow, or, at least porous, the solid parts being where they are the most used, the rest being left without the filling that is found in heavy animals. Even their quills are simply strong tubes, very tough and rigid, but with all their strength near the surface. Part of the feathers themselves are so finely divided and interwoven as to present a large surface to the air.

If a drawing of a skeleton of a bird be made, we shall find that it is quite small compared with the bulk of the body. The air which fills some of the bones, and is also held in air-sacs connected with the lungs, is warmed by the warmth of the creature, and is therefore lighter than the outer air, especially when the bird is in the higher regions where the air is cool.

THE WING OF A BIRD.

The wing, as most of us know, is really a changed arm and hand. The bones of the bird's arms are made long, slender, and light, and the hand is reduced to little more than one finger, though there are some remains of the others. All these bones are inside the skin, so we must not think that the feathers have anything to do with the skeleton. They are an outgrowth of the skin itself, just as are scales, and hair or nails. To move the wing with force and rapidity there must be big muscles, and these are found in the breast muscles that are attached to the ridge of the breast-bone. We do not need to be told that, usually, the breast of birds is delicious eating, and it is made up of these great muscles. It is natural that the well exercised muscles will furnish delicious or nutritious meat.

DIFFERENT KINDS OF FLIGHT.

While the lighter birds fly, for the most part, by moving their wings rapidly, some of the larger birds are much heavier in their make-up, even when we consider their size, and they depend more upon sailing or gliding than upon wing strokes. Though they must use the flapping wing to some extent, especially when rising in the air, yet once in flight, they may be seen gliding and sailing on motionless wings. For many years men have seen that such great birds as the condor, the vulture, the eagle, and the large hawks, would remain in the air for long periods without moving their outstretched wings; but this was not understood until there had been much study of the currents in the upper air, and of the gliding flight that is now seen in our aeroplanes. In fact, it is not fully understood today. Some think that the great birds are able to find rising currents of air, and to use these in lifting themselves to heights from which they can make long glides and spiral descents. In fact, this matter of gliding or floating in the air was so little understood that all the earlier attempts at flying machines were

based on imitation of the flapping wing, but were failures. Men could not make engines strong enough, and at the same time light enough, to drive a wing that would carry any weight much greater than the engine itself. Men have not been able, as a rule, to imitate animals in motion on land, on water, or in the air.

ADVANTAGES OF THE WHEEL.

There is a reason for this. Men have found that the best way of using power is by means of the turning wheel. Using the wheel, they can make machines that travel faster than animals run upon the land, or swim in the sea; they may even hope some day to approach the birds of slower flight in the air. This is because the wheel goes straight on, while the animal's way of motion requires the limb to go forward and back again. Thus a horse's leg must be brought forward again after each step. The locomotive wheel moves ever ahead. The propeller of a steamer is more like a fish's tail, but it is a little more effective, as it need not change its form in making the strokes.

We need not go into this further than to say that while there is a great advantage in the wheel, it can not be used by any of the animal world, for a very simple reason. In order to turn completely around, a wheel must be separated from that on which it turns. If a wheel had been created as the limb of an animal, it could never be nourished or renewed or repaired from the rest of the body, since no veins or arteries could be connected with it. It is this that has kept men from gaining most by most closely imitating animals. It is an example of how mankind have found, by means of reason, something that for a given purpose is better than what the natural world shows them.

TEMPERATURE OF BIRDS.

Although there is no doubt that the earliest birds came from animals that were reptiles, and, like the reptiles of today, were cold-blooded, yet as birds have

developed, their blood has become warmer until now no other creature is so warm-blooded. The bird's temperature is highest in the best developed, ranging from a hundred to as high as a hundred and twelve degrees, while the temperature of mankind is a little more than two degrees lower than a hundred.

FOSSIL BIRDS.

Although a few fossils of birds have been discovered, it is believed that they are rare because of their lightness. Most fossils have been preserved by being embedded in mud, after having sunk in the water or in the wet sand. Birds were too light to sink easily, and so their bodies were likely to have been devoured by other animals or to have gone to pieces before they could be preserved in the newly forming rocks. It must also be remembered that when some change of climate, or some of the great changes of the earth's surface, caused the death of many land creatures, the birds would be able to escape by flight, and even if they perished, it would be by ones and twos, rather than in immense numbers in any one locality.

The first undoubted fossil bird was discovered in 1861 in Bavaria. It was about the size of a crow, and the impression in the rocks shows a part of the skeleton, many of its feathers, and especially the quills. There are several very remarkable things about this early bird. One is the extension of the backbone into a long tail resembling that of a lizard, and having a row of stiff feathers on each side of it, one after the other. On the forepart of each wing were three distinct finger-like members, bare of feathers, and each armed with a claw. These were probably of great assistance to the creature in climbing about trees, as the wings themselves were undoubtedly weak and incapable of long sustained flight. In South America there exists today a strange bird called the hoazin, on whose wings there are two such fingers, by means of which the

young help themselves in climbing, as did the bird of old. In the modern bird, however, these free fingers are of use only before the wing-feathers are fully developed. In one other important respect the fossil bird differed from any living species—in the possession of true teeth set in the jaw, for apparently there was no horny beak, such as all modern birds have.

BIRDS DESCENDED FROM REPTILES.

This fossil, which has been called *Archæopteryx*, meaning “ancient-winged-creature,” is of the greatest interest, since it shows what a close connection there has been in the past between the reptiles and birds. In fact, it is taken as proved by naturalists that they have a common ancestor. Among extinct reptiles the one that most nearly approaches the bird in structure, is one of the great Dinosaurs, whose front limb is supposed to have become modified first into a flipper for swimming, and in course of many ages, into a wing-like organ useful for short flights in the air. But by the time that anything resembling mankind appeared among fossils, the birds had become very different from reptiles.

We are therefore to think of birds as arising from a lizard-like animal, having teeth, a long bony tail, and yet possessing the deep breast-bone and wing-like limbs of modern birds; a creature that gradually became fitted at first to climb, then to make long leaps, and at length to fly. The long history of this change undoubtedly took many thousands of years before the bird could support itself for any considerable time in the air.

OTHER ANCIENT BIRDS.

Scientific men have discovered in recent years the fossils of many curious forms that may be put between this earliest bird-like creature, and the simpler forms of modern birds. Among those found in our own country is the gigantic *Hesperonis*, a diving-bird with

enormous webbed feet, set far back on the body, so far, in fact, that it was probably unable to walk. The wings became much reduced in size from lack of use, until they at length disappeared almost entirely. The head and neck were long, and the slender jaws were furnished with sharp teeth perfectly adapted for capturing the fish upon which it lived. In South America a giant fossil bird has been found, called *Phororhacos*, some specimens of which attained a height of twelve feet. This enormous bird had a head somewhat like that of an eagle, but, unlike the eagle, it was without the power of flight, and so had to run down its prey.

THE MOA, THE DODO, AND THE GREAT AUK.

In the islands of New Zealand many species of ostrich-like birds have been found, some of which reached a height of ten or more feet, so that a good-sized man could walk upright between the legs. These birds have been called moas. Many skeletons of them have been obtained from deposits to show that they were in existence within recent historic times—certainly within the past five hundred years. The moa of Madagascar, *Æpyornis*, laid an enormous egg even in proportion to the size of its body—one that is thought to have given rise to the mythical “roc” told about in *Arabian Nights*. Specimens of these great eggs have been found, from time to time, in the tombs of buried chiefs. Among more recently extinct birds is the dodo, a short-legged, heavy-bodied bird that became exterminated soon after its discovery on the island of Mauritius. It was related to the pigeons, but had an enormous head and bill and large feet. The body was very fat and round, and covered with soft feathers like those of the ostrich. The wings, although fairly well developed, were useless for flight, and being stupid and slow-running, the dodo was soon killed off by the Portuguese and Dutch sailors, who landed on the island in search of food in the early part

of the seventeenth century. A picture of one of these birds was made about that time by a Dutchman, and this, together with the complete skeletons that have been found buried in the mud of lakes on Mauritius, give one a very good idea of the appearance of this ridiculous looking bird.

Another interesting bird that lived in more recent times was the Great Auk, nearly related to existing species of auks, but considerably larger, being about two and a half feet high when sitting in an upright position. It was without the power of flight, though possessing small wings. This bird has become absolutely extinct within the past century, but some of its eggs are still in existence, and are highly prized by collectors. Scientists are unable to find any satisfactory reason for the disappearance of the Great Auk, as it inhabited rocky islands in the far north, and therefore was probably not killed off by man.

GROWTH OF FEATHERS.

Though at first sight it seems hardly believable that from the skin can be grown things so different as the scale of a great fish, the teeth and nails of wild creatures, and the delicate feathers of birds, yet by the use of the microscope for the study of the growth of a feather, we can trace the whole method by which the feather is produced from a scale-like growth which gradually becomes longer, and splits up into tiny plumes. The camera and the microscope together have given us pictures of this marvelous process. Nor is the process finished; indeed it is scarcely begun, when the first resemblance to the feather shape appears. From this, according to the needs of bird life, have been brought about that wide variety of plumage which serves every need of warmth, dryness, flight and beauty. Most marvelous, perhaps, is that remarkable change whereby the tips of some feathers gradually break up into fine white greasy powder, that

becomes distributed through the plumage, serving to protect it from vermin and to help keep the body dry and the feathers in good condition.

It must never be forgotten that every feather of a bird's make-up will be found to have its reason for being; that the form, size, color and way of growth of every feather will help us to know something of the bird's way of life, either in the present or in the past.

THE GREATEST ENEMY OF BIRDS.

The living birds, having fought their way through millions of years, are now threatened by mankind, the most dangerous of all their enemies. Though beyond our reach while in the air, yet all must come to earth and risk its dangers.

A work of art may come again and be recreated, but, as Mr. Beebe says in his admirable book on *The Bird*, when the last of a race of living beings breathes no more, another heaven and another earth must pass before such a one can be again. He therefore appeals to all against needlessly ending even one such life, and begs that each species be saved from extinction. For, speaking generally, there is hardly one whose good work does not far outweigh any harm it may do.

A DIAGRAM SHOWING WORK DONE BY BIRDS.

A very excellent representation of the good done by birds, especially those that live about our farms and cultivated grounds, is given in the frontispiece of a book meant to show the benefits we derive from birds in central North America.

This frontispiece is merely a diagram, showing at one end a bit of a house, and then along a line are sketches of trees and shrubs to represent, first, the yard, then the garden, the orchard, the fields, woods, and even a bit of pond. Opposite each part of the line is given a list, first of the insects that are found in the part of the farm represented, and next a list

of many bird enemies of these harmful creatures. Above, a space is left to represent the air, the left hand being the air by night, and the right the air by day. In this manner one gets quickly a clear idea of how each kind of bird may be considered as a sort of police force, charged with the duty of protecting a portion of the farm. While it is true that the bird is acting for its own benefit, yet that does not in any way affect the value of the work done for ourselves.

THE POLICE OF THE AIR.

There is no need to repeat all the facts that are so closely put in the little drawing that we have described, but we can at least give a few items from it that will help us to see how completely the soldiers of the air, the scouts of the thickets, and the police of the woods, look after the little wrongdoers who rob us of our crops, or who do sometimes greater harm in other ways. In the air, by day, there are ten species of insects here listed, beginning with flies, butterflies and beetles, and ending with the winged gnats, plant-lice, and grasshoppers. In the list of air-police who are ever on the watch to catch these pests, we find the swifts, so commonly called "chimney-swallows," the little bird of such amazing powers of flight, the swallow, hardly inferior as a flyer, the martins, king-birds, and the friendly phoebe, and several others, all birds of great swiftness, tireless on the wing, and ever busy sweeping the air, seldom missing the little prey which itself is scarcely less rapid in flight.

At night the work is taken up mainly by the night-hawks and the whippoorwills, who find their food in the moths, mosquitoes, and other outlaws of the dark. It is hardly needful to tell which birds help to keep our shrubs and small fruits in the gardens near our houses from being completely ruined by insects. Their very work keeps them ever before us. The sparrows, wrens, warblers, robins and birds of their kind, can

be seen even from our windows, darting about, peering like tiny detectives into every crevice and under every leaf, ransacking every bit of turf or clump of grasses, evidently securing many a good meal, as their plump condition and constant activity prove.

THE ORCHARD PATROL.

If we enter the orchard, we shall find the woodpeckers and nuthatches, one right side up, the other perhaps upside down, running over the bark of the trees, picking from cracks and bores the many creatures that crawl upon the surface or dig into the substance of the trees. The chickadee, the warbler, and the vireos, pay attention to the leafy portions, removing the tiny hoppers or aphides that feed upon the juicy green leaves. The worms and caterpillars are sought by the bluebirds, cedarbirds, and thrushes, so that altogether there are eight species of birds, at least, who see to it that insects shall not thrive at the expense of our orchards.

In the same way, when we enter the meadows we shall find ourselves interested by a new sort of feathered detectives, whose beat includes every square foot of turf that may harbor grasshoppers, worms, grubs, and root-borers. The meadow-lark, the blackbird, robins and sparrows, each here finds the food it prefers, and helps to keep the pasture sweet and edible for the cattle. The same birds, with a few others, will be found also looking after the crops that grow in fields, removing from them the grubs or worms or ants that if unchecked would soon make the fair fields a blighted ruin.

After this, we shall understand that as we enter the thinner or the thicker woods, and find them occupied by the brown thrasher, the catbird, and other busy workers in feathers, that these too, are doing a good it is impossible for us to estimate; that bird life is supported only through the destruction of myriads

of harmful insects, which, without their aid, would swarm everywhere, and, indeed, if left to themselves, must soon perish through the destruction of the very woods in which they now lurk.

WAR WITH ROBBERS AND PIRATES.

Wherever you find birds, you will find also the creatures upon which they prey, and by knowing how they go to work, we shall have pointed out to us the hiding-places of insects upon which they live. Shore-birds find plenty of worms in the soft mud they pierce with their long bills. On the pond surface the ducks and geese eagerly pursue the wrongdoers who have given up robbery of the land to become pirates of the water; and they likewise serve to keep the surface clear by removing much waste, as has been found where swans and ducks have been placed upon park lakes, making unnecessary the work of many men who used to be busy in keeping the water free of rubbish.

WHAT THE GOVERNMENT FINDS OUT ABOUT BIRDS.

The work of the Government is given especially to three main objects: (1) to find out exactly what is eaten by the common birds in which farmers are interested; (2) to receive complaints made against certain species and to decide whether they are well founded; (3) to print and send out reports that will teach the public the facts in regard to these and similar matters. All this work is done in the most careful manner. To find out what birds eat, thousands of stomachs are examined, and the nature of the food made certain by comparing its remains with the collections in the museums, whether of birds or insects. Then experiments are made to see whether the facts so found out are generally true. It is only after this work is done that it is possible to pass right laws for protecting species that are helpful, and for the discouragement of those that are harmful.

ONLY ONE BIRD IS CONDEMNED AS AN ENEMY.

An instance of this work is that done in regard to crows. After long and careful study, it was found out that the crows *did* eat corn and fruit, and the eggs of some other birds, but that none of these kinds of foods were much taken; and so it was decided that little harm was done in comparison with the very valuable work done by the crows in the killing of insects and mice. This showed that the farmer could easily afford to lose a little of his corn in view of the enormous amount that was saved to him by the killing of insects and mice.

Crows are so cunning that they are able to take care of themselves, as is well known to every farmer's boy; but still it is well to remember that, on the whole, the big black fellows do more good than harm. In the same way it has been learned that woodpeckers, hawks and owls, with a few exceptions, and nearly every wild bird, may be considered among the friends of the farmer, and do him little harm. There is but one bird that is condemned on all hands. After the fairest of trials, the English sparrow has no voice raised in his defence. He is an enemy to other birds, and a pest to the farmers.

Even where birds show their fondness for certain kinds of fruit, it is not difficult to protect the orchards from them if they are provided with certain wild fruits which they prefer. But it must not be thought that there is no harm to be traced to any of the birds, since a few of them, among the flycatchers, are said to live partly upon kinds of insects which can not readily be spared—bees for example. Yet the king-bird (the one chiefly accused) eats mainly the useless drones, and makes up for this by the harmful insects it kills.

All who are interested in these matters may easily get from the Government very interesting reports known as "Bulletins," which tell in simple language

which birds are good, which do harm, and of their value to the farmer and gardener. Enough has been done already to show that *nearly all* birds deserve to be kindly treated, and encouraged to live near our homes, and in our fields. If now and again it shall be found out that there are mischief-makers among them (as in the case of the English sparrow), the men who are constantly busy in making up reports on the birds' conduct, will be sure to let us know of it promptly.

THE QUESTION OF IMPORTING BIRDS.

It is anything but an easy matter to come to correct conclusions, since in order to know the value of birds' work we must first know, also accurately, all the harm or good wrought by the creatures upon which they live. There have been mistakes made in the past when species that are not at home here have been brought from foreign lands, with the idea that they would do for us the same work that they had done abroad.

The English sparrow did destroy the throngs of inchworms that ate the leaves of trees in our cities, and were an every-summer nuisance; but when once they had disposed of these, the sparrows, which increased very rapidly, turned to other foods, and, indeed, began to eat almost everything, losing the good reputation they had won, and becoming themselves a nuisance which it is going to be difficult to combat.

The English starling, it may be, will become another problem of the same kind, and it is the opinion of the wiser bird-students that bringing foreign birds into the country is something that should only be done with the utmost caution, if done at all.

DIFFERENT KINDS OF FOOD.

It used to be common to call some birds "insect-eaters" and others "grain-eaters," but the results of

recent study have shown that we can hardly say that any one species confines itself to either class of food. It depends very largely upon what food is plentiful and what is scarce. We do know, however, that as eaters of seeds, birds seem to prefer those of plants which may be called weeds, for many of them are useless or even harmful. Finches and sparrows may be seen busily picking the seeds of dandelions, horse-weeds and thistles, and the common ragweed would no doubt spread a thousand times more widely except that so many birds are fond of the seeds. Those who help to keep down this harmful weed form a very long list.

It may be said generally that the efforts of the farmers to rid their fields of weeds would be utterly hopeless except for the small helpers who descend upon these plants as soon as they come to seed-bearing. The grasses, and the wild rice also contribute largely to the support of these friends of the farmer, and even where the same birds may be found feeding upon the grain crops, yet, as has been said before, it is probable that nearly all of them more than pay for their meals by killing insects that would eat a hundred times more than their little wages.

It is not to be denied that now and then birds descend in large flocks upon grain fields, and at such times do harm to the fields attacked; but this is a trouble that is sure to diminish as the fields become more plentiful, and the birds fewer. *We are more likely to suffer from lack of birds than from lack of grain.* A food that can be more readily spared to the inhabitants of the air is formed by the seeds of trees. The elms, the birches, the maples, and several other trees, bring forth seeds so abundantly that there is enough and to spare, both to feed the bird-flocks and to plant the young trees. The pine-trees hide their nuts so carefully that only a few birds can extract them from the cone. The crossbill has even acquired

its remarkable bill of which the two parts are so curved and crossed as to fit it to the withdrawing of the seed from its pocket. The spruces also guard their seeds nearly as carefully. Seeds of the hemlock can be more easily extracted. There is little danger, therefore, that the birds will threaten the tree-crop; they are not able to get at the nuts, for example, easily enough to endanger our supply of this sort of food.

Of fruits and berries birds eat a great number, but they seem quite as ready to feast upon those for which mankind does not care, as to choose those which we consider far better worth eating. We can not deny that at times they do injure the crop of fruits, but we may say, as we have already said of the grain, that it is fair to regard what they take as a very reasonable payment for the good they do in killing insects. At all events, birds are not so bold that it is difficult to protect from them the fruits and berries we especially desire, and if they are fairly provided with enough food of a less valuable kind, or if we do not greatly interfere with the natural supply of such inferior food, there seems no reason why they should be regarded as dangerous enemies to our orchards.

FRIENDS AND ENEMIES.

Even before there was any true science that taught men the truth about the life of birds, and the good and the harm they do, it was impossible that men should not notice that certain species seemed to be their enemies, while others either did no harm, or even might be regarded as friends. The farmer could hardly do his work without seeing that some of the seed from which he hoped to raise a crop, came up by the help of busy feathered thieves almost as soon as it was put into the ground. Even the boys who hoped to enjoy fruit from the trees or berries from the bushes, must have been again and again disappointed to find that flocks of sharp-eyed fruit-lovers

had come before them and stripped all of the plants of their choicest treasures. Again, it was seen that the poultry-yard had its enemies, not only upon the ground, but in the air.

KNOWLEDGE THAT WAS NOT SCIENTIFIC.

But not all the birds seemed to be enemies. When there came insects, whether in great throngs of crop-destroying locusts, or in the busy armies of devouring worms or bugs, men always found that they were not left alone in their attacks upon these countless foes. The coming of the insects meant also the flocking from the heavens of their feathered destroyers, and even the most selfish farmers could not fail to see how much he owed to the birds' help. But, unfortunately, the ordinary man judged too quickly whether a bird was a friend or an enemy, and even if it was discovered that the bird did some good, it was enough for the farmer to notice also that the same bird now and then seemed to be doing harm to his crops or his food-supplies. He was not wise enough by himself, nor had he been taught, so the puzzle put before him was not an easy one to guess: whether any special bird was a friend or enemy. If a hawk was seen to carry off a chicken, it was enough to make the farmer and his sons declare war thereafter against all hawk-like birds that came into view. Nor did they know for many a long year that they were putting the sins of a few birds of this species to the discredit of far distant cousins, who were either blameless, or all things taken together, should be reckoned as friends.

THE WORK OF THE SCIENTIFIC MEN.

But when there was sufficient knowledge to lead men to the careful study of birds, and when, about two centuries ago, naturalists gave their lives to careful watching of birds, and study of their habits, there began to be gathered together the information that

was to point out clearly which of the air people were friends, which were enemies, and which were wholly neither one nor the other. True, many of these men studied birds merely for the love of it, and not with the idea of first benefiting the practical workers; but as the truth came to light it was seen that the mistakes which were made through ignorance were of an importance little dreamed of. It was learned that the benefits coming from the work of birds in a community were hardly second to any work for the good of mankind. These men who traversed the wilderness and told what they learned, paved the way for others who worked more directly for the benefit of all of us.

In the middle of the nineteenth century the true science of this subject began. Articles and reports were published showing how useful birds were, leading to the conclusion (as stated by Wilson Flagg in 1861) that "each species of birds performs certain services * * * which can not be so well accomplished by any other species." These papers excited much interest, and the question was for the first time put: How much do we owe to the birds, and which birds should be cared for merely for selfish reasons? About twenty or thirty years ago, the Government of the United States, in its Department of Agriculture, took up the study of the worth of birds, and has followed it with the most important results ever since. This has shown that the whole subject is so big and so important that it is beyond the powers of any private individuals, and well worth the attention of the Government for the benefit of all the people.

CHAPTER XXXII.

The Long Contest Between Men and The Wild Animals.

NIVERSAL peace is today a subject much discussed by all civilized nations, and we are gradually learning to appreciate the enormous benefits to be derived from such a happy condition of affairs. Unfortunately, however, while man is partially able to control his own affairs, he finds himself continually at war with the great forces of nature. In the infancy of the race, these opposing elements were a real menace to his very existence, but in modern times man has, by his wit and ingenuity, learned how to avoid many of these dangers.

The life of primitive man must have been one long struggle against roving beasts of prey, and the larger grass-eating animals. We, in these later days, secure in our comfortable homes, can hardly appreciate the terrors of our early ancestors, as they crouched in damp caves listening to the howls and roars of great beasts of prey—the huge sabre-toothed tiger, or the clumsy, but formidable, cave-bear. Imagine, if you can, the life-and-death struggles that went on between man and these mighty brutes. How poor and ineffective were his early weapons, perhaps at first a sharp stick or a jagged stone, and, later, a rough spear with a stone head or a bow and arrow.

There seem to have been, to judge from the fossil remains, two or three kinds of carnivorous animals which waged continual war against our unfortunate ancestors. Chief among these, so far as we know, were the larger feline (or cat-like) animals, the wolves, and the bears. These three great types are still on earth,

although in very much reduced numbers, thanks to the invention of firearms and other deadly weapons which man in his struggle was forced to employ.

In civilized countries, at any rate, the number of dangerous animals is annually decreasing, but in many semi-civilized parts of the world they are still very plentiful. In Europe, and even in England, wolves existed until quite recent times, while they are yet common in many provinces of Russia. We find many remains of the cave-tigers and cave-bears in nearly all the European countries, but in historic times, at least, the greater felines had vanished, although bears were comparatively common.

In Asia, however, a very different state of affairs obtains; there are great numbers of tigers and leopards in many parts of that great Continent, particularly in India, China, and Sumatra. Every year thousands of people are killed by these savage creatures, the timid native being quite helpless against their attacks. Whole villages are sometimes terrorized by a single tiger or leopard, which, before some English sportsman finally dispatches it, will kill a surprising number of people.

There is an inherent aversion in the Hindu mind to the killing of any wild creature, there being a current belief that the soul of a departed relative might be inhabiting it. The sporting Englishman, however, has no such scruples, and considers it a rare chance to obtain a fine tiger- or leopard-skin whenever he hears of one of these marauders in his locality. Indeed, were it not for these same sportsmen, armed as they are with firearms, the number of natives killed by wild animals would be simply appalling.

WILD BEASTS PLENTIFUL IN AFRICA.

In certain parts of Africa, as well, a man's life is not safe unless he is well armed, lions being still abundant in the less civilized portions of the great Conti-

ment. Indeed, while the Uganda railroad was being constructed a few years ago, numbers of men were killed by them. The negro population, however, unlike the Hindu, has no religious scruples against the killing of dangerous creatures, and therefore the days of the lion and leopard are numbered over the greater part of the Dark Continent.

In our own country the danger from wild beasts seems never to have been very great, our largest cat, the puma, being an arrant coward, while our timber wolves, although larger and formidable enough, have not been known, apparently, to attack a grown man. While this is the case, it in no wise lessened the fear which our forefathers had of them, and many thrilling stories are told by early settlers in various parts of the country about their adventures with wolves, bears, pumas, and wild-cats. There can be no doubt, too, that a hand-to-hand encounter with any of the creatures just mentioned, was no child's play, and it is quite possible that many an Indian and solitary white hunter has lost his life in fighting with one or another of these various animals.

It may be generally stated, nevertheless, that, so far as the United States is concerned, the danger from large wild beasts of prey has practically ceased.

MANY GRASS-EATING ANIMALS SOMETIMES DANGEROUS.

We are not accustomed to think of the grass-eating animals as dangerous, but experienced men tell a different story,—such animals as stags, cattle, the elephant and the rhinoceros being at times very formidable. The males of all species of deer are savage in the fall, at which time their horns are fully developed, while the domestic cattle, particularly the bulls, and cows with young calves, are sometimes very aggressive. The hunting of the elephant and the rhinoceros is always attended with more or less danger, and many

fatal accidents are on record in which an enraged or wounded animal has charged with disastrous results, the hunter being unable to escape.

In Africa, the native farmer suffers greatly from the inroads of hippopotami, these huge creatures trampling down and destroying great areas of growing crops.

The maternal instinct or love of the young, is a very powerful one in animals, and many creatures which are timid and inoffensive for the greater part of the year become savage and aggressive when they have young. This instinct is not confined to the mammals, but includes birds, reptiles, fishes, and creatures still lower in the scale.

As a rule, all wild animals will flee at the approach of man, but if wounded or cornered they will fight desperately, and it is always dangerous to approach too closely a wounded animal, or one that fancies itself cut off from an avenue of escape.

DANGEROUS BIRDS OF PREY.

The birds of prey, while very destructive to animal life, rarely, if ever, attack human beings. Many stories are told of eagles swooping down and carrying off young children, but these tales, when investigated, usually prove false. When wounded or brought to bay, however, many of the larger birds of prey are truly savage fighters, striking out viciously with their sharp talons and dealing heavy blows with their powerful wings. The attendants in zoölogical gardens often suffer severely from the beak and talons of some refractory eagle who refuses to allow itself to be shifted from one cage to another, fighting desperately meanwhile when the keeper attempts to seize it. The grasping power of an eagle's foot is something terrific, the sharp talons locking themselves into the flesh so that it may be necessary actually to cut the tendons of the bird's leg in order to make the claws release their hold.

SOME LIZARDS ARE OUR ENEMIES.

Among lizard-like reptiles, the crocodile is the only species which is really dangerous. This great scaly saurian, lurking, as is its habit, among the reeds of tropical rivers or lakes, will often seize and destroy an unfortunate person who has occasion to approach its lair. There are many authentic instances of this character in Asia and Africa, but so far as we know, our own Florida crocodile does not attack human beings. It is commonly supposed, in this country, that the alligator acts in the same way as its eastern relatives; but the statement has not been verified. One must admit, however, that a large alligator *could* make short work of a man if he wished to do so, and we may be excused for having an instinctive dread of these repulsive reptiles.

The lizard family, other than the crocodiles, are regarded with aversion by many people; but, so far as is known, only one species out of a great number found in different parts of the world, is really poisonous. This is the Gila monster, from the southwestern portions of the United States, a fairly large lizard, some two feet in length, curiously banded with black over a salmon ground. The head is black, and very broad at the back, and the tail is short and round. It is a ground-living species, inhabiting holes which it digs for itself with its powerful claws. The poison is found only in the teeth of the lower jaw, and while it may be fatal to small creatures on which the animal feeds, it is not so to man. This animal is very sluggish in disposition, and is induced to bite with great difficulty, although, when sufficiently irritated, it seizes the offending object in a strong grip, holding on tenaciously, after the manner of most lizards.

The large and ferocious lizard known as the iguana, found in the southern parts of this country and in South America, can, when attacked, defend itself with great energy; and this ability extends to the other



CHAMELEONS.—These odd little creatures have eyes that move independently—one may look backward, while the other looks forward; they have five-toed feet and a long tail, which, like monkeys, they use in climbing.

large members of the group, such as the monitors and several allied species.

Most lizards are armed with powerful claws, and strong jaws filled with sharp-pointed teeth. Unlike the snakes, they have considerable courage, and will spring upon and hold an adversary like a dog, scratching and biting viciously. The flesh of the lizards is excellent eating, and seems to contain no harmful constituents.

This is not the case with certain species of fishes, whose flesh is decidedly poisonous at all times. Persons eating these fishes are afflicted with a disease known as ciguatera, a malady often fatal. Other species are poisonous only at certain times of the year, and some only after they begin to decay.

EVEN SOME FISHES HAVE WEAPONS.

As a class, the fishes are well provided with offensive and defensive weapons of various kinds, some being armed with sharp teeth, others with long and pointed spines, which may or may not be poisonous, while certain varieties are animated electric batteries, able to deliver powerful shocks when in contact with an adversary, as will be mentioned later.

The sharks are undoubtedly the most formidable of all fishes, and are very much dreaded by the inhabitants of the islands scattered through the southern oceans. These great and sinister creatures literally swarm about the coral reefs and low sandy islands of the West Indies, while many species have a still wider range, being found throughout the Atlantic and the Pacific Oceans. One variety, the Greenland shark, is a great nuisance to the whalers of the far North, crowding about a freshly killed whale and biting lumps of blubber from the huge body.

The great white shark, the blue shark, and the tiger-shark, are all regarded as dangerous; but nearly all species, whether large or small, can inflict terrible

wounds with their lancet-like teeth. There is a popular fallacy that a shark must turn on its back before seizing its prey, but this is not the case, the creature being quite capable of grasping an object while swimming in an upright position.

Sharks are very graceful and powerful swimmers, their long tails forcing them through the water at great speed. On our shores we have little to fear from these creatures, as our local species, although quite capable of inflicting severe bites, are not at all aggressive, but are, on the contrary, very cowardly, fleeing in alarm at the approach of a bather or a person in a boat.

FISHES WITH BATTERIES AND POISONOUS SPINES.

The rays, large flat fishes related to the sharks, are able to inflict powerful wounds with their long whip-like tails, as this member is usually armed with sharp and poisonous spines. The spine itself seems to contain no real poison gland, but the mucus which surrounds it has very irritating qualities. We have most of us felt the sharp pricking sensation caused by the spines of our common catfish or bullhead, and the rough, sharp scales of the yellow perch. Many fishes are even better protected by a spiny armor which covers them from head to tail, and can be erected at the will of the owner. The porcupine-fish, found in the West Indies, is a species having this means of defence. The tang, or surgeon-fish from the same region, carries a sharp spine enclosed in a sheath on each side of the tail, with which to gash an enemy. In fact, the offensive and defensive armature of the fishes reaches a very elaborate and varied development, and one which serves them in good stead on many occasions, since they are constantly pursuing or pursued.

Several members of the family, however, are still more effectively armed, as they possess the power of delivering severe electric shocks, powerful enough to



FORMS OF MEDUSÆ.—A kind of Jelly-fish found floating in the salt water, and admired for its beauty.

temporarily stun a man. Foremost among the electric species is the electrical eel, or gymnotus, found in the streams of South America. So strong is the shock given by this slippery creature, that it must be handled with great caution, as the effect is decidedly unpleasant, though not at all dangerous. The same power is possessed in great measure by the electric catfish, a native of Africa, and by various other species found in different parts of the world.

The North Atlantic has one fish, the electric ray, or torpedo-fish, which gives a very severe shock when incautiously handled, but the effect soon wears off, causing no lasting injury.

JELLY FISHES, SEA URCHINS AND THE OCTOPUS.

Far more lasting in disagreeable features is the harm experienced from contact with some of the larger jelly-fishes, and the very beautiful, but poisonous, Portuguese-man-of-war, or physalia. These lovely creatures are exceedingly unpleasant to touch, and may on occasion be the cause of very serious complications. They both are found in great profusion throughout the warmer portions of the Atlantic Ocean, and undoubtedly have caused the death of many people bathing in those regions. The long, delicate tentacles of the Portuguese-man-of-war extend a great distance through the water, and woe betide the unlucky fish which may come in contact with them. They contain a vast number of stinging cells, which, when they touch any living creature, instantly inject a poison into the system causing a temporary paralysis, and enfeebled heart-action. The writer has experienced this feeling which lasted for about four hours after the first shock of the wound. There can be no doubt that a person swimming in the ocean, and becoming entangled in the tentacles of the physalia, would at once become paralyzed and sink unless help was at hand.

Some sea-urchins, and even the lowly sponges have

the stinging properties developed to a high degree. There is a large deep red sea-urchin in Bermuda, which has long black spines radiating from it in every direction. These spines are quite poisonous, causing a decided irritation of the flesh for some days. The sponges are covered with tiny points, or spines, which are easily detached, and become imbedded in the skin of a person handling them. This causes great irritation, intense itching, and actual pain, the skin peeling from the wounded parts after some weeks.

HIDEOUS DENIZENS OF THE OCEAN.

Of all the denizens of the ocean, perhaps none inspires man with greater horror than the octopus, whose eight arms, covered with powerful suckers, are used to grasp its prey and convey it to the beak-like mouth. These singular creatures are found in nearly all oceans, but seem to attain their maximum size in the colder parts of the Atlantic and Pacific. Specimens measuring twelve feet across are on record, large enough to seize and hold a man without any difficulty. The smaller species abound throughout the coral reefs of the Hawaiian Islands, and are there used as food by the natives, who catch them in a remarkable manner.

CAPTURING THE OCTOPUS.

The duty of searching for the octopus usually devolves upon young women, who walk about upon the exposed portions of the reefs, prying into the holes and crevices of the coral rock. When an octopus is found, the damsel thrusts her hand into the orifice where it lurks, and with a jerk drags out the wriggling creature, whose long arms lash about on every side in an effort to seize the offender. Then follows the most curious and revolting part of the performance, as the girl with a quick movement buries her teeth in the body of the octopus and bites into the soft flesh of the neck. At this moment, an observer tells us, the maiden looks like a veritable Medusa, as the writhing arms of the

“devil-fish” twist and turn about her head, reminding one of the fabled snaky locks of that sinister female told of in Greek mythology.

THE SQUID OR CUTTLE FISH.

As is usual with many hideous and loathsome creatures, a great many thrilling tales are told about the octopus, or his near relative, the squid, or cuttle-fish. The last-named creature grows to an enormous size, indeed forty feet or more in length, with a body some five feet in diameter. The eyes are large, and very fierce in expression, and two of the eight arms are much larger than the others. Not all squids, however, grow so large, the best known species averaging perhaps two feet in length.

The smaller kinds exhibit a most wonderful coloring while alive, caused by various shades of pigment which flush back and forth over the body of the animal, like the ever-changing lights of an opal.

CLOUDING THE WATER FOR PROTECTION.

Both the squid and the devil-fish have the power of ejecting at will a very dark fluid known as sepia (and often used by painters), which serves to protect them in case of attack. This fluid clouds the water for some time, making it impossible to see the whereabouts of the creature, which seizes the opportunity to dart away to a safer place before the water is again clear.

In the countries bordering on the Mediterranean, the squid is often eaten by the inhabitants, but the flesh has little flavor, and is tough and uninviting. The suckers which cover the under side of the arms are used merely to hold the prey, and not, as is supposed by many people, as actual suckers to draw out the blood. The real destructive power is confined to the parrot-like beak, which lies concealed beneath the circle of flesh formed by the bases of the arms. With this beak the squid can inflict a severe wound, and for this reason, when attacked, squids endeavor to draw them-

selves over the prey. If, however, they are themselves frightened, they merely seize and hold off an adversary, much as a man would grasp the wrist of an enemy armed with a knife or revolver.

When placed upon land, the octopus is a most unpleasant looking object, as it partly raises itself upon its long arms and endeavors to regain the water. If frustrated in this attempt, it will hurl itself furiously upon its tormentor, and at such times nothing in the whole range of animal life is more horrible or repulsive.

The giant squids have long been regarded as dangerous creatures, and the earlier writers recorded blood-curdling stories of whole ships being engulfed in their murderous embrace. A better knowledge of the facts, however, has, as usual, put an end to these gruesome yarns, and modern naturalists have found that the squid serves chiefly as a dainty morsel for the sperm whale. We have all read, without doubt, the graphic account in Jule Verne's celebrated novel, *Twenty Thousand Leagues Under the Sea*, of the battle between the crew of the "Nautilus" and a school of cuttlefishes. Like many other things in that intensely interesting book, this incident is pure fiction, and serves only as a convenient medium for displaying the writer's vivid imagination.

ALL SNAKES ARE NOT POISONOUS.

The snakes comprise a branch of the reptile family which are truly to be dreaded by man in all hot and temperate climates, although in this case a vast amount of rubbish is taken for truth by an ignorant public, which implicitly believes all sorts of weird tales current about these curious and interesting creatures. Just here let me make it clear that not *all* snakes are dangerous, by any means, only poisonous kinds being really a menace to mankind in general.

The snake family is divided into three large groups:

poisonous snakes, those which obtain their food by the action of the poison which is secreted in glands at the back of the head, and injected into the wound made by the snake's fangs; the harmless snakes, that is, those having small teeth, but no poison, and which simply swallow their food while it is alive; and the third class, comprising the constrictors, etc., the largest members of the family. These are not poisonous, but kill their prey by crushing it in the folds of the body.

It is only the first group from which man has much to fear, and many of these are exceedingly dangerous. India and the islands of the South Pacific, Australia, and parts of Africa, contain many very poisonous snakes. Europe has a few species, while the North American Continent contains but four which are really deadly.

In India the cobra ranks easily first as a constant and terrible menace to the native population, while in Australia there are very many poisonous forms.

ONLY FOUR POISONOUS SNAKES IN THE UNITED STATES.

In the United States there are, as stated, only four really poisonous kinds—the rattlesnake, copperhead, moccasin, and coral-snake. All other known varieties are perfectly harmless, although, when driven to it, they may bite rather savagely.

Rattlesnakes are spread over a large portion of this country, and are usually found in rocky ground or open prairie country. They do not, as a rule, care much for the vicinity of water. The bite of a rattlesnake may or may not be fatal, according to the location and severity of the wound. Fortunately, the creature is very timid, and will not, so far as known, advance upon an enemy, contenting itself by coiling and waiting the approach of the offender. For this reason a person is perfectly safe unless the snake is actually within striking distance, or is trodden upon.

It is not able to strike more than a third of its length, so that the range of efficiency is very small.

THE "MOUNTAIN RATTLER" AND THE "DIAMOND BACK."

Throughout the Eastern States we have the variety known as the "mountain rattler," which pretty well describes its habitat, as it is usually found in rocky and hilly country. In the South the large "diamond back" lives in the thick palmetto and live-oak scrub which covers large areas of our Southern States. This species, while the longest of the family (specimens measuring seven feet in length) is a particularly timid form, and will always prefer to run away rather than to fight. Naturally, in so large a reptile, the bite is very severe, the great fangs piercing through a person's shoe or clothing deep into the flesh. The poison acts very quickly, and the bite is usually fatal, but (and here to reassure those timid people whose vacations are often spoiled by the fear of meeting a snake of any species) the number of persons actually bitten or killed by snake-bites in this country is so small that it is hardly to be estimated. When we consider the millions of people who, in summer, are wandering through the woods and swampy portions of the United States, we can easily see how groundless are our fears in regard to the possible danger from poisonous snakes.

THE COPPERHEAD STRIKES VERY QUICKLY.

The copperhead, our second poisonous species, prefers wooded country to the open and rocky haunts of the rattler. Owing to its protective color, which very closely resembles dead leaves, the copperhead is often difficult to distinguish, and is therefore somewhat dangerous to persons groping about through leaves or bushes in search of rare plants or flowers. Unlike the rattlesnake, the copperhead is a rather touchy creature, and will strike very quickly at any one approach-

ing it too closely. Its bite is very seldom fatal, however, and its range is so restricted that it is really not highly dangerous.

THE MOCCASIN'S HEAD IS LIKE THE "ACE-OF-SPADES."

The moccasin, a large, stout species found throughout the Southern States, is much dreaded by the negroes and those whose work keeps them in the swampy country of Louisiana and Florida. This species is really a water-snake, and is very often confused with the true water-snake, which in the South grows to a large size and inhabits the same localities. They are readily distinguishable, however, by any one who is not too frightened to observe properly. The moccasin has a broad, flat, "ace-of-spades" shaped head, and is a very thick snake in proportion to its length, whereas the water-snake has a small round head with protruding, bead-like eyes. In color, too, they differ much, but most people are so confused at the sight of one of these fat and ugly reptiles coiled on some projecting stub rising out of the swamp, that they can not truly distinguish one from the other. It is fair to assume, however, that at least half the snakes reputed as moccasins are in reality harmless water-snakes.

THE TINY EYES OF THE CORAL SNAKE.

Our fourth poisonous species is really so rare and difficult of approach that it hardly counts in the list at all. This is the beautiful coral-snake, a native of Florida, and one of the most gorgeously colored snakes in the world. It is a small species, living in holes in the ground, and for this reason is seldom seen. The colors are orange, red and black, arranged in large bands alternating with one another on the snake's body. The head is small, not broader than the neck, and the eyes are very tiny, as befits a ground-living animal that seldom looks at objects far from it.

With this brief list we conclude the species of poi-

sonous snakes in the United States, and it seems a very small one indeed for so large a territory. Our harmless species are much more numerous, but the bite of all is so slight that no alarm need be felt by any person so bitten. Some species, particularly the black-snake, are fierce and somewhat aggressive, but the needle-like teeth hardly draw blood, and the bite is absolutely harmless in effect. In fact, the wounds made by the teeth of the largest snake in the world, the great python of India, can not compare in severity to those inflicted by a rose- or blackberry brier.

ABSURD YARNS TOLD ABOUT SNAKES.

Before leaving the snake-family, we will say that of all classes of creatures, the snake-family leads in the great amount of nonsense that is written about them. Even intelligent people will accept as truth most absurd stories concerning the habits of certain perfectly harmless varieties. First among these come the marvelous tales of that mythical creature, the "hoop-snake." No such species exists, yet many blood-curdling yarns are told of people being pursued by one of these "dreadful brutes!" It is said to coil itself in a circle, taking its tail in its mouth,, and in this position to roll after its unfortunate victim with deadly intent. When it wishes to stop, it simply digs its tail, which is armed with a sharp spur, into some convenient tree, and thus arrests its onward flight. Now, nothing could be greater nonsense than this story, from first to last, yet many otherwise well-informed people really believe it. Probably it began as the humorous invention of some imaginative country boy.

Another accomplishment equally foolish is ascribed to the coach-whip snake, a real species, so called on account of its resemblance to a braided whiplash. This creature is supposed to twine itself around a fence-post or stump, and from this vantage-

point to lash people with its tail. This is certainly a good companion to the hoop-snake yarn, and can be dismissed at once as false, and wildly absurd.

A third statement which should be very strongly refuted, is the story among our Eastern farmers that our common hog-nosed snake is a poisonous species. This perfectly harmless creature goes under the dreadful names of "puff-adder (the true "puff-adder" is a very poisonous snake found only in Africa), "spitting viper," and "blowing viper." Nature has developed a remarkable habit in the hog-nosed snake—that of flattening out its neck and body, and hissing or puffing loudly in order to ward off a threatened attack. It is only a sham, nevertheless, as this snake can not even be induced to bite, much less to injure any one, and its alarming attitude is simply a bit of acting for its own protection—what may be called a "bluff."

BOA-CONSTRICTORS AND PYTHONS.

The third class of snakes, the great constrictors, comprises the boas in South America and the pythons in Asia, Africa, and Australia. All these snakes could undoubtedly destroy human life, but as a matter of fact, they seem never to do so. They are all more or less timid in disposition, and as a rule frequent deep forests or remote streams. Here the boa-constrictor lies in wait for its prey, birds and other game, and by making the folds of its body tighten about its victim, holds it in an iron grip until life is quite extinct. In spite of its great size and strength, however, man has little to fear from any of the species, when wild. In captivity, the great reticulated python, a mighty reptile, twenty-five feet in length and eight inches in diameter, is somewhat savage. The keeper, who is obliged to enter the cage containing one of these huge snakes, is always provided with a blanket which he quickly throws over the glittering monster, temporarily blinding it so that he can go about his business in comparative safety.

SNAKES NOT SUCH A MENACE AS INSECTS.

Although all of the preceding species of animals may, at times, be more or less enemies to man, their depredations are as nothing compared to the inroads upon human life and health, caused by the countless millions of noxious insects which are particularly aggressive in hot countries. Among these the common house-fly, the mosquito, fleas, the tsetse fly, and a host of others, present a really stupendous problem for man to cope with. The savage and semi-civilized peoples of the world have never done anything in the way of destroying these insect pests, and it is only within comparatively recent years that the great danger from them has been fully appreciated. An army of skilled investigators is continually at work in these enlightened times making war upon the insect hosts and trying in every way possible to reduce and keep in check these tiny enemies of the human race.

HOUSE FLIES, CATERPILLARS AND MOSQUITOES ARE PESTS.

We now know that the common house-fly is a great source of disease, while some species of the mosquito are regarded as the sole causes of many dangerous and fatal fevers. The tsetse fly, an insect inhabiting Africa, has been found to convey the germs of that dread malady known as the sleeping sickness, while fleas, ticks, and other insects which feed upon animal food are known to be great distributors of disease germs. The list of insect pests is, in fact, a very long one, and lack of space forbids doing more than mentioning any but the better known forms. The subject is a new one, and has been studied only recently with any thoroughness.

Besides those harmful insects already cited, there are the great caterpillar armies which every year destroy millions of dollars worth of fruit and vegetable products, while many beetles, such as the boll-weevil which destroys the cotton, the potato-bug, and thou-

sands of other destructive forms, go to swell the grand total of noxious insects. Indeed, it may truthfully be said that the suffering entailed upon the human race by insects far and away surpasses that imposed by all other forms of animal life. The bright light of science, however, has now been turned upon many of these vital problems, and the results obtained, while far from complete, are very encouraging and instructive. At the same time we are coming to realize the very important fact that all of the living forms in the great world about us are objects worthy of our thought and study, and that they are not always seeking to attack and destroy mankind, as was the belief of our forefathers, but are a part of the great scheme of nature, at once the most complicated and fascinating fields for human research.

CHAPTER XXXIII.

Animals As We See them in Captivity.

AS men have gradually taken possession of a great part of the world, the wild animals have either been killed or driven away to the desert, and wilderness, and thick forest jungle, where they are seen only by travelers and explorers, or by the natives.

Most young people, therefore, never see these creatures except in zoölogical gardens, where their lives differ greatly from the lives the same animals lead when at liberty.

Formerly, such gardens or menageries were little more than collections of cages, and the captive beasts led a miserable existence. But now the great collections of animals are usually in charge of men who give them the right surroundings and as much liberty as possible. Great tracts of ground are prepared, and with the right food and proper care many of the creatures thrive, and give us a good idea of what they were when at liberty. But, even at best, a zoölogical park is not the open country. The change of climate, the new surroundings, and the confinement in cages, or in small enclosures, often cause disease, and tend to keep the animals from successfully rearing their young. So all conditions must be as near as possible to those the animals are used to in their own countries, and new animals must be constantly added in order to keep up the supply and vigor of the species.

MUSEUMS FOR PRESERVING SPECIMENS.

Only by studying these animals can young people have any true idea of what the creatures are, or what



THE TAMANDUA.—An Ant-eater of tropical America.

they were in the past; this must be learned by going to the museums where can be seen the earlier forms from which those animals of today have sprung.

The custom of keeping wild animals in captivity doubtless began at a very early period in the history of the human race. We can imagine with what glee the prehistoric youngster greeted his father when that grimy person brought home a tiny bear, or a spotted fawn as a plaything for the little one, and that the antics of the young creature were a source of unending delight to the child.

ANIMALS IN CAPTIVITY.

From these small beginnings, a desire to know more about the habits of wild animals became almost second nature in the mind of man. We read how, in the early Egyptian and Roman eras, wild and savage beasts were brought to these countries from the East, and either exhibited as curiosities, or used in the great and bloody spectacles which took place during festival displays.

As man became more civilized, his knowledge of the subject took a wider scope, and certain individuals began to make a special study of animal life. Aristotle, the Greek philosopher, was himself much interested in the life of the world about him, and formulated a system of naming and classifying the different species of animals. It remained for modern man, however, to advance the science of keeping animals in confinement as a means of furthering our information regarding their lives and habits.

NOTABLE ZOOLOGICAL GARDENS.

For many years the larger European cities have maintained important exhibits of wild animals, chief among them being the Gardens of London, Paris, Berlin, Amsterdam, and Antwerp. The Jardin des Plantes, at Paris, is, we believe, the oldest of these institutions, and, while far from being the most complete,

it has nevertheless served as a place of study for many celebrated naturalists and artists. The great Cuvier there found inspiration in the large collections of wild creatures, and Barye and Fremiet, the noted animal sculptors, spent many long and strenuous hours in their observation of the animals confined there. Our knowledge of the best methods of keeping these creatures in a condition of health and comfort is of still more recent date. As it is possible to tell about only a few, we shall select those that require particular care and attention, saying nothing of those that are less interesting, even if much rarer.

CARE AND DIET OF MONKEYS.

It has been found by experience that some animals are much more difficult to keep than others, and for this reason certain species are practically unknown in collections. The monkeys, owing to their delicate constitutions, seem to require more particular attention and care than possibly any other animal, but as the vast majority of people are interested in them, a special effort is always made to keep up a satisfactory exhibit. One would naturally suppose that a great amount of heat would be necessary for the health of these creatures, since they are natives of warm climates, but repeated experiments have proved otherwise. On the other hand, it was found that plenty of exercise, sunshine, and fresh air, were absolutely essential to their existence, and that a comparatively low temperature gave them greater strength and energy.

The ideal monkey-house, which will combine all of these features, has yet to be constructed. In the matter of food, as well, much care is necessary, as an attack of acute indigestion is likely to prove fatal to these delicate animals. At one time they were fed principally on bread and milk, but this diet has given way to one composed of fruit and vegetables, varied occasionally by insects, eggs, and other animal products.



CHIMPANZEE.—He eats like a human being and can dress and undress himself.

LIONS, TIGERS AND LEOPARDS.

These animals require plenty of room in which to exercise, and for this reason, as well as from the fact that they are a very important group, they usually are given a separate house. In the more recently built zoölogical gardens immense cages of heavy wire, with solid partitions between them are provided for these magnificent creatures. This gives them a chance to show off their lithe and graceful forms to the best advantage, and at the same time gives them an opportunity to pace back and forth when taking their much-needed exercise.

In these cages the floors are made of wood, as cleanliness is the first requisite for keeping the specimens healthy, and although less natural than an earthen floor, they are far more practical. The boards are scrubbed and disinfected every day, and while the hard substance causes rheumatism in some of the inmates, yet they are spared greater ills by the better sanitary conditions, and a generous litter of straw is often provided to soften the otherwise unyielding floor of the dens.

Besides these conveniences, another in the form of a bathing-pool is often provided for the tigers, whose fondness for water is quite remarkable.

RULES FOR FEEDING THE FELINES.

Although special food is required for the feline animals, it is fortunately of a kind that can readily be provided. For this purpose freshly killed beef is often given. The objection to it arises from the fact that it is not always possible to get it freshly killed; it is often kept on ice, which lessens its nourishing qualities. The smell of the meat seems to have a very exciting effect upon the big cats. They arouse themselves from their usual attitude of indifference, and pace back and forth in a state of feverish expectancy, sometimes turning upon each other in a frenzy of jealous anger at sight of the approaching food. The amount of exercise

which they get in this way is considered a very necessary part of their daily regime, as they are naturally indolent, and only exert themselves under some strong incentive. Experience has demonstrated the fact that for most of the flesh-eating animals, a fast of one day every week is required to keep them in good condition, as in a wild state they are often obliged to remain without food for long periods, traveling great distances, meanwhile, in search of prey.

THE INTERESTING TIGER CUBS.

The young of all the cats are very interesting little creatures, but, for various reasons, are difficult to raise in captivity. Chief among these is the lack of proper food at certain stages of their development. While very small, they are nursed by the mother, who is a most excellent parent, but after the growth of the teeth it becomes necessary to substitute some food other than milk, and it is at this period that the greatest care is necessary in order to procure a substitute for their natural diet in a wild state. Such solid meat as beef or horseflesh is far too heavy and tough for the purpose, and a warm broth of soup is usually put before the greedy little fellows. In their ignorance and eagerness they are apt, at first, to lose most of their dinner by instantly plunging their chubby faces into the pan, whereupon the greasy liquid fills their bleary little eyes, and gets up their noses, much to their disgust. During the proceedings they spit and growl at one another in a very ferocious manner; but they soon become accustomed to the new method of feeding, and waste no time in disputes.

WASHING THEIR FACES AFTER EATING.

It is very amusing to watch their clumsy efforts at cleaning themselves after their performance, but the really serious moment comes when the mother lion takes her turn at this daily washing. This proceeding



THREE STRIPED BEAUTIES.—These circus favorites, like ourselves, vary in disposition. Some are savage, others milder. A trainer soon learns that in dealing with wild animals he must be kind, patient, firm, and always alert. In the arena he is as far from effective help as in the forest.

is submitted to with very poor grace by the unfortunate cubs, but is nevertheless conducted in a very thorough manner by the fond parent, whose rough and prickly tongue scrapes every particle of dirt from their stocky little bodies.

As they grow, and their digestion becomes stronger, they are fed chopped meat in small quantities, and later this is superseded by freshly killed chicken or rabbit. This latter diet is of prime importance, as flesh is a powerful stimulant, and serves to build up the young animals in both bone and muscle.

About this period the youngsters become quite important in their own estimation, and amidst the general confusion at feeding time are heard to give forth tiny growls and roars—small beginnings of the terrible sounds that, later on, will issue from the throats of the adult animal.

At about this stage in the growth of the cubs a special keeper is detailed to see that they do not receive too much attention from the public. It is a great temptation to pet the furry little creatures when they approach the bars, but, for various reasons, it is unwise, and even dangerous, to do so. In the first place, this undue familiarity has a very bad effect upon the mother, who is naturally overanxious for the welfare of her offspring, and will, if too greatly excited, neglect or even destroy them, in a paroxysm of fear. At the same time, the continual fondling may render the cubs very tame. One must remember that the safest plan to adopt in dealing with wild animals is to leave them alone as much as possible, and to maintain a certain dominance over them, which is very important in cases of emergency.

THE BEAR FAMILY.

The bears comprise a group of animals whose droll antics in captivity are a never-ending source of amusement to visitors. For this reason, all zoölog-

ical gardens of importance maintain a collection of these clumsy creatures. Unlike other animals, the bear has the power of standing erect upon his hind legs, after the manner of a man; this character alone would make him an object of general interest, as he stalks about, sniffing the air and waving his fore legs about in the most absurd fashion.

The practice of keeping bears in captivity is an old one. The dens, as a rule, are sunken below the ground, and lined with stones. In the center of the enclosure is placed a stout pole, or stump of a tree, up which the bears climb in their eagerness to grab the buns and other dainties offered them by the spectators. The practice of keeping the animals in this way, however, is fast falling into disuse, and the latest zoölogical gardens merely exhibit them in a large and unroofed enclosure, surrounded by a heavy grating of bars, as bears are extremely powerful creatures, and much given to prodding with their dexterous paws the weak spots in their cages.

WHEN THE BEARS BATHE.

Bears are very fond of water, and will, if given the opportunity, spend much time in their favorite element. This partiality is not confined to the polar bear, much of whose life in a wild state is spent in the sea, but is shared by the large brown and grizzly bears, who like nothing better than to plunge into the bathing-pools and splash the water about to their hearts' content. Besides giving the animals much pleasure, it serves to keep them cool in hot weather, as otherwise they would suffer much, owing to their long and dense fur. Polar bears, in particular, require much water to keep them in condition through the summer months, although it has been found best to keep them out of the pool during the early spring, when they are apt to contract pneumonia from the too sudden cooling of their overheated bodies in the chilly water.

BEARS' WRESTLING AND BOXING MATCHES.

Wrestling and boxing seem to be favorite amusements with bears, who show great dexterity in dodging about, and avoiding the heavy blows dealt by their companions; one wonders at the strength and activity exhibited by these ponderous creatures, as they swing back and forth locked in each other's embrace, or strike right and left like professional boxers.

Bears in captivity will eat almost any food, a fact which renders them comparatively easy to provide for; bread, meat, vegetables and fish are equally acceptable to these ever-hungry brutes. Polar bears are fed, as a rule, upon fish, although they readily learn to eat other things. They are, however, more carnivorous in their taste than are the other members of this animal family.

In a wild state, bears hibernate—that is, become torpid—through the long, cold winter months, when it would be difficult for them to find food; but in captivity they show very little inclination to do so, as they are well fed and warmly housed. The matter of housing, however, is of little consequence, as the thick layer of fat beneath the skin, and their long, shaggy fur, render them practically immune to cold. In fact, as a class, these animals are singularly tolerant of both extremes of temperature, and are quite indifferent to anything but hunger or intense pain.

THE MOTHER BEAR AND CUBS.

Several cubs have been born and reared in the New York Zoölogical Park, and these little creatures always prove a fascinating exhibit. The mother bear must be approached with caution at this time, as she is apt to be very ugly and aggressive. When first born, the young are tiny creatures, thickly covered with hair and with their eyes tightly closed. This latter condition exists for several weeks before the little ones can see at all, and during this time they are given the best of care by their devoted parent.

Just as soon as the youngsters can see, however, they more than make up for lost time, and gambol about in a most amusing way, rolling and tumbling over each other like young puppies. With plenty of food and exercise, they grow very quickly, and are soon able to take their places with the older members of the colony.

THE ELEPHANTS.

Greatest of all the beasts of the field, the elephant has always been an object of interest to the human race, and in early Roman days was a source of wonder and awe. The ancients employed the elephant in war, and in our own day, the Rajahs and other potentates in India regularly use them in tiger-hunting. Their great strength is also employed in peaceful occupations, much of the teak-wood of Ceylon, for example, being transported by these powerful and intelligent creatures.

NO CIRCUS COMPLETE WITHOUT AN ELEPHANT.

In zoölogical gardens they are always a great attraction, being often trained to carry children on their backs; and no circus would be complete without one or more of these huge animals. They can be taught many tricks, and they have an astonishing capacity for peanuts and other trifling dainties.

The Indian species is the one usually seen in captivity, but occasionally the African variety is exhibited. The celebrated "Jumbo" belonged to the latter class. Elephants in a wild state spend much time in water, bathing and splashing about, in order to rid themselves of the various stinging insects which abound in hot countries. The water seems also to soften their thick, hard skin, and elephants in captivity sadly miss these daily ablutions, unless special care is taken to give them a thorough rubbing with oil at frequent intervals. In Washington, a large tank has been provided for the comfort of the captive elephants, and in this they take daily baths.

DIET OF ELEPHANTS IN CAPTIVITY.

Elephants in confinement are not very prone to disease, and, barring accident, will live many years in a domesticated state. They eat enormous quantities of food, hay forming a large part of their diet, which is otherwise varied by vegetables, bread, and fruit. Elephants, especially the males, are often given to attacks of anger, during which they are very vicious toward their caretakers or anyone else within their reach. At such times they have to be more heavily shackled than usual, and no one is allowed to go near them, as the gigantic creature is able to kill a man with one sweep of his powerful trunk. At other times they are comparatively gentle, but should always be approached with caution, as, in spite of their great size, they are panicky creatures, and apt to run away under the impulse of sudden fear.

THE AMERICAN BISON, OR "BUFFALO."

Bison, or "buffalo," as they are commonly called, which were almost exterminated a few years ago, have, through the foresight and energy of a few people, been saved from complete extinction, and even bid fair to increase in numbers. For various reasons, it would be impossible for them ever to attain the great numbers which formerly overran the great plains of our western country, but in all probability the lesson that man has learned through his wanton destruction of this useful and typical American animal, will prevent his ever taking a similar course with any other creature. At one time it seemed to be the plainsman's idea to get rid of the buffalo, and he slew them in the most ruthless manner. The flesh was too common to be appreciated as food, nor was it needed for that purpose. The tongues were the only part of the animal considered worth eating, and the carcasses were left on the plains to be devoured by any carnivorous beast or bird that chose to feed upon them. The hides were sold for as little as a dollar apiece, and,

other than the pleasure it gave the hunter to kill them, there was practically no use made of the buffalo. No one could foresee, when vast areas of this country teemed with uncounted thousands of these beasts, that in an incredibly short time no effort or expense would be spared to save the last few survivors.

BUFFALO PROTECTED BY THE GOVERNMENT.

Reservations have been set apart by the Government for the purpose of breeding the bison. They are rigidly protected, and any one who molests them is punished by a heavy fine. Probably the largest reservation is the one in Oklahoma. The Zoölogical Society of New York presented to this park a few years ago, ten of the finest cows in their herd and five bulls, and under the care of a "cowboy," they reached their destination in safety.

FROM CAPTIVITY TO LIBERTY.

The process of moving these animals was very interesting. A narrow wooden runway was erected extending the entire length of the enclosure in which they had their quarters at the Zoölogical Park, a gate opening into it. At the other end of the runway was a car made of heavy slats, with spaces for air. Into the car the animals were to be coaxed or urged, a mixture of both methods being employed before the move was effected, each buffalo needing both force and persuasion before it would enter the runway. In the adjoining enclosures the herds who had hitherto chewed their cuds heedlessly, began to feel that something unusual was happening, and a general air of uneasiness was conveyed to them all. Though not showing any great alarm, probably because they had for so long had nothing to fear, they suddenly became deeply interested, and lifted their heads the better to see what was going on.

One of the animals, an old bull, began to object to

the procedure. He showed decided signs of resentment, poking the bars with his enormous head, and with the whole force of his body beating against the obstacle. Snorting and bellowing, he shook his head threateningly, until, seeing the futility of his efforts, he dropped heavily upon his knees, and with a vicious impatience plowed the earth with his big sharp horns. In the meantime one of the men had brought a rope, in the end of which he made a slip-knot.

SHIPPING A HERD OF BUFFALO.

One attempt after another was made to rope one of the cows, but in vain. Stoically she waited until the rope fell, then with one shake of her bushy head, she disengaged herself from its meshes. A happy thought prompted some one to place a bundle of hay near the car, and with bated breath the onlookers watched the cautious approach of the hungry animal. She came just near enough to reach out and grasp a mouthful of the food, and then scampered away. For some time thereafter there was nothing done that did not instantly excite the suspicions of the now thoroughly alert creature. At last, a small army of men surrounded the enclosure and kept up a continual beating on the bars with sticks, shouting and hooting until the cow became confused and, rushing first to one side, then to the other, was driven into the car, whereupon the door was closed and the bolts made fast. This will give some idea of the difficulty of shipping the entire herd.

GOATS AND DEER.

Moose, caribou, and wild sheep, are almost impossible to keep in captivity, on account of the high altitude in which they live, and the special kind of food they require, and which is not to be had near the sea-level. The only zoo in this country that has raised successfully the Rocky Mountain goat is the Bronx

Zoölogical Park, in New York. This achievement was accomplished only after the complete failure of the first attempt. The first specimens of these animals brought from the Rockies, died soon after reaching sea-level, presumably from eating certain grass that disagreed with them. The experiment of plowing up the ground and reseeding it was tried, and upon this new grass the next flock of Rocky Mountain goats were found to thrive. They stood the summer remarkably well, and the following year several young were born, all of which were perfectly healthy and strong; these lived through the critical period of their youth, and some of them are now rearing young of their own. The original colony have grown to be large animals, and in winter have long, luxuriant coats.

HOW THE GOAT ASCENDS THE STAIRS.

There are steps leading from the ground to the roof of their house, and it is an interesting sight to see these hoofed creatures climb up and down the almost vertical stairs. The high rocks at the back of their enclosure also give them an opportunity to indulge their instinct and inclination for climbing.

KEEPING DEER ON A SMALL RANGE.

Deer are kept on ranges large enough to afford grazing, and they also feed upon the leaves of the trees, which are very good for them. The hills and rocks of their adopted homes are such as they are accustomed to, but necessarily on a smaller scale. Virginia deer are also difficult to raise, because most of the zoölogical gardens are near the level of the sea. Sometimes, when an animal can not be given the food and surroundings to which he has been accustomed in the wild state, efforts are made to accustom him to other food and to a different climate and surroundings. In some cases it is comparatively easy to accomplish this; but even when the experiment succeeds,

and the creatures seem content, they rarely, if ever, have young; and the collection has to be renewed by importing new animals from their native places.

THE BEAVER AND HIS CURIOUS HOUSE.

The beavers are placed in large enclosed ponds containing trees, which they gnaw down, using the twigs and branches for constructing their dwellings. These they cement together with mud, a plentiful supply of which they bring up from the bottom of the pond. It is wonderful with what cleverness these animals do their work. The larger trunks are discarded as being too heavy, but the smaller ones are used for their dams; and it is asserted that when the trees are gnawed through, the wise little creatures manage so that they fall in the right direction for their purpose. The house which the industrious beaver builds for himself is so arranged that the winter quarters are entirely above water, while the entrance is below the surface; in other words, there is no outside entrance. In appearance the house resembles a large mound about three feet high. Many sticks enter into the construction. The beavers are as ready to fight as they are to work, and so it is hard to keep many specimens together.

BIRDS IN CAPTIVITY.

For some reason not clearly understood, certain species of brilliantly colored birds seem to lose their color after being a short time in captivity. The scarlet ibis, for example, fades to a delicate salmon pink after the first moult, while the flamingo becomes almost pure white. Various experiments have been tried in order to restore this color, but have met with only partial success. There must be something in the food eaten by the bird in a wild state, which is lacking in that provided for them in captivity.

One of the greatest difficulties encountered in all

zoölogical gardens, is the comparative lack of space in the cages provided for birds, and this necessitates confining many species and individuals in the same enclosure, which often leads to disastrous results. Certain birds—herons, storks and cranes, in particular—are apt to kill one another if placed in too close quarters. Others, if given large and roomy cages, will get along very well, but great care is always necessary in placing strange individuals together for the first time. For this reason, many birds must be kept apart from all others. The great marabou storks, for example, are condemned to a solitary existence, owing to their murderous propensity. They stand idly about, most of the time, dozing the hours away, and awake from their lethargy only at the welcome sight of the keeper bringing their allotted portion of fish. This they gobble greedily, swallowing their food whole, in great gulps.

THE DELICATELY COLORED MARABOU.

In appearance the marabou is a strange mixture of beauty and ugliness. The exquisite blue-grey feathers of the body and wings contrast rather painfully with the almost naked skin of the neck and head, the latter having a few curly feathers on the crown. The soft and delicate feathers which are known to commerce as “marabou” are found under the body near the base of the tail, and are barely visible as the bird stands upright on its long and ungainly legs.

THE DIET OF THE BIRD OF PARADISE.

The extremely beautiful and rare birds known as birds of paradise are very seldom seen in confinement. In fact, until quite recently, no specimens had ever been seen in this country. They are difficult to keep, as their diet in a wild state is an extremely complex one, and it must, in one form or another, be supplied

to them in captivity. These birds are fond of fruits, particularly oranges, grapes, and bananas, and this is often varied by animal food, ants' eggs, finely chopped meat, etc. In fact, the food of most birds requires much thought and study, some living well on simple fare, others demanding many different things in order to maintain them in condition.

KEEPING THE BIRDS IN CONDITION.

The moulting period is always a very critical one with birds, and much anxiety is felt by those having them in charge during this period. They often experience difficulty in properly shedding their feathers, and unless this is accomplished the health of the bird will suffer. It is often necessary to pull out some of the larger feathers by hand, in order to assist nature, but great care must be exercised to avoid injuring the delicate skin.

As with other creatures, birds suffer from diseases, but many of these can be prevented by proper treatment, and isolation of the individual afflicted. All in all, the keeping of a bird collection is no easy matter, and eternal vigilance is a prime requisite, if these charming creatures are to be kept in presentable condition.

SOME WATER BIRDS AND OTHERS.

Ducks and geese are provided with large ponds, surrounded by fences, and also with houses in which they can take refuge in case of severe weather, and in which they can lay their eggs, if they choose, instead of hiding them in the bushes. These birds seem thoroughly to enjoy their lives, and, after the first season, make few attempts to fly away. It is, therefore, unnecessary to clip the wings after the first time. Occasionally some of the wild species will visit distant places during the day, but they always seem glad to get back at night, and comparatively few indulge in

this roving habit. The collections in most parks are increased every year by flocks of wild species that voluntarily take up their residence with the half-tamed members of their family.

COMING OUT TO WARM THEIR FEET.

These birds make little use of their houses, most of them preferring to swim about on the water or doze on the banks. In winter, they resort to the ponds where the ice has been broken up for them by their considerate keepers, coming out now and then to rest upon the frozen surface, covering their feet—the only part that seems to feel the cold—with their feathery bodies.

In the aquatic houses, where these are provided, birds that are natives of a warmer climate have almost as pleasant an existence. The temperature is suited to their requirements, and water is conveniently placed for their accommodation, with trees and other roosting spots.

ANIMALS HAVE CHARACTER.

From these accounts of certain typical animals, it will be seen that each has its likes and dislikes, its choice in food, its good or evil disposition, its love of company, and its desire for solitude.

In old times men studied the ways and the habits of animals so that they might kill them or might capture and tame them. By this careful study, and by superior cleverness, men learned to overcome and destroy dangerous animals, or to tame and keep such creatures as were found useful.

Now the same study is given to their management so that they may be kept alive and in good health, though no longer at liberty, and may be studied for our education.

Once this study was merely to gratify a taste for knowledge; but, since men have come to believe that



TWO ALBINO WOODCHUCKS.

our own species began by passing through certain forms more or less like those of animals still in the states we have passed through, it is realized that we can learn much of our own bodies and minds from study of animals.

Thus we can trace the beginnings of the brain, of the eye, the ear, the sense of smell, and so on. We can understand how they came to be, and by noting how they have changed in the past, may see what will happen in the future.

WHAT ZOOLOGICAL GARDENS OFFER.

Thus the study of animals promises to be helpful in many ways—though few nowadays need to study them as in the past, when they were hunted for food and clothing.

And the same thing is true, or truer, as regards the life of plants, the Botanical Gardens offering to the students of vegetation what the Zoölogical Parks offer to those who mainly study animals. Plants, too, have their characters, their own ways of life, and their fixed habits, which must be known and turned to advantage in order that mankind may live to the best purposes.

In this volume we have seen that man has become what he is through knowledge of what is on the earth, in the sea, and in the air—through finding out the uses of all that has been put under his control.

Part IV.

WHAT NATURE TEACHES US.

CHAPTER XXXIV.

The Wonders of Nature.

E might in one sense fairly say that everything in nature is a wonder, for there is nothing in the world that fails to excite our wonder and admiration when it has been carefully studied.

From the tiniest grain of sand upon the seashore to the most impressive mountain-range, from the littlest creeping thing to the hughest beast, or largest bird of prey that soars high above us in the sky, there is nothing that is completely known and understood. As soon as we begin to study anything we very soon come to ask questions that we do not know enough to answer. Even a small pebble—a bit of rounded granite, or a bit of quartz crystal—has its laws of formation from which it never varies, and builds up its faces and angles in ways we do not fully understand, though they have been studied for years. And when we go on to plant and animal life, the problems become even more difficult.

REASONS FOR EVERYTHING.

Yet we know enough of nature already to be sure that all things are made to grow and develop according to a plan and an order. The fin of a fish, the claw of an animal, the wing of a bird—each comes to be as it is to suit some purpose, to carry out some plan, to answer a need.

We have already considered some of these adaptations, especially in the chapter on the "Mysteries of Nature," and have seen that as the world of nature has changed, so living creatures have changed also to suit their surroundings. It is not very long ago that it was discovered how very great these changes have been in the course of the millions of years of our earth's life, and how very different plants and animals were once from what they are today.

In order to live and to leave young behind them after they are dead, plants and animals have gone through ages of work, of fighting, of effort. Naturally, therefore, there have been strange plants and strange animals, fitted to live amid the greatly varied surroundings.

We shall find that "queer" creatures are queer only because they have lived under unusual conditions. The great polar bear, with his thick, furry coat and hooked claws; the blind mole, with soft, velvety fur, and fore-paws made for digging; the long-legged stork with spear-like bill; the lace-winged insects, and the squirming worms—all have good reasons for being as they are. And all are wonderful, because they are so wisely shaped and planned to suit the differing lives they lead.

THE UNUSUAL IS THE WONDERFUL.

So it is that we must admit that everything is a natural wonder; and when we speak of the "wonders" of nature, we can mean only the things that, being unusual to us, seem especially marvelous.

To the African, the zebra, the antelope, the elephant; to the Eskimo, the seal, the walrus, and the arctic hare; to the Laplander, the reindeer—are the ordinary animals. When the ancient Mexicans first saw the Spaniards on horseback, they thought man and beast were one creature. Each thought the animals he knew less wonderful than those he did not often see.

To us who live in temperate regions, the daisies and the dandelions are ordinary; but the tropical plants—the palms, the bamboos, the cactuses—are wonderful. It is a matter of what we are used to, and what is strange and therefore not understood. Of such “wonders,” we shall not here speak. Our final chapter will deal rather with the things that are wonderful because they are very different from most other things of the same general kind.

THINGS WONDERFUL IN COMPARISON WITH THEIR KIND.

Thus, among the mammals, certain ones have always been objects of wonder to us because they are so big—as the elephants, the rhinoceroses, the hippopotamuses, and the giraffe. They are big compared with ourselves, and big compared with all other land creatures. In the sea, the whales are wonderful for the same reason.

But when we learn about animals in the past, we find that these creatures, big as they are, are but small when they are compared with the enormous creatures of past ages—the skeletons of which have been dug out of the ground and put together in our museums. The elephants are but small descendants of such great animals as the mammoths and the mastodons that lived in what is known as the great ice age; and even the mammoths can not be thought enormous when they are measured against the great plesiosaur, a sea-animal that was more than twenty feet long, and the brontosaurus, that was nearly twice as big.

When we know that such creatures lived, we must recognize that our biggest animals are not to be compared with them. There were other giants of past ages—a great beaver, an enormous sloth, and enormous birds of the ostrich kind, for example.

Why these were so big, and why their modern types are so much smaller—no one knows. We can see that the modern animals have bigger brains, and

this may have something to do with the decrease in size; or possibly food is less plentiful and harder to get at.

As some animals are smaller than their kind once were, so others are larger. The horse, from being a little animal (perhaps two or three feet high), has become big and heavy. The ox is larger, and so are many kinds of dogs.

And the same thing may be said of plants—they have grown larger in some cases, smaller in others. There are some with leaves several feet across (like the *victoria regia*, or the palm), others with leaves that are mere specks of green. There are trees that tower three or four hundred feet into the air, like the California redwoods, or the Australian gum-trees, and others that are mere shrubs in size, dwarfed by being starved or chilled in the upper air of mountain regions or in the arctic cold.

In the same family, the grasses, we have the little tufts of green that cover the meadows, and the lofty bamboos that are trees in all but name. Among reptiles we find all varieties in size from the tiny newt to the great alligator; among fishes, the fingerling minnow and the enormous sturgeon, shark, grampus, and swordfish.

The wonders of size among plants and animals are puzzling indeed. We do not know why some should be microscopic and others gigantic.

FORMS THAT ARE MARVELOUS.

The question of size is puzzling enough, but it is a simple matter indeed compared to that of form. Creatures may be just big or little, light or heavy; but in examining the forms of natural things we enter upon an endless study. Not only are the different kinds utterly unlike, but there is constant variety even among those of the same kind. From the very simplest round cell of jelly-like matter we find both plants and animals

built up into every imaginable shape. The cells are strung out in long strings or built out into stars, crosses, pendants, rings, loops, lace-like fringes; into sacks, tubes, ribbons; and then these are combined into forms of fairy-like creations even to form what are called the "lowest" animals—such as are found in every pool of water, or upon every weed or mass of vegetation. Books of exquisite pictures are needed to show even a chosen few of the ornamental forms of life to be found in ocean pools or along shore.

When we come to "higher" creatures the same wonderful structure exists throughout every part of the animal, both internal and external. The very scales on a butterfly's wing, the hairs of every furry creature, the eyes, the ears, the skin—every feather of a bird, petal of a flower, each part of a leaf, or organ of fish and insect, whatever we may study, is found to be a work of beauty and of wonder, even if its form alone be considered.

And then all these minor works of wonder are combined into the creature itself—making up a wonder composed of wonders.

Consider a trout darting amid the currents of a brook, a swallow's long glide in the air, an elephant crashing through the thick jungle, a butterfly or hummingbird poising above a bed of flowers—and each is a separate wonder of nature, if its form alone be thought of, and a thousand times greater wonder if we remember the intelligence that directs its movements, the mystery of life embodied in that living form, and its relation to all the life around it, both plant and animal.

THE MYSTERIES OF COLOR.

Size and form being understood, we shall have next to ask about coloring. And here we enter upon a new set of studies that promise endless entertainment and instruction. We shall find coloration for mere beauty—and yet we shall find coloring where no eye

can enjoy it, as in the very heart of great rocks, or in the darkness of the deep sea. We shall find coloration meant to attract the eye—as in the beautiful markings of certain birds—and coloration meant to deceive the eye—as when animals are made to resemble the things amid which they are accustomed to hide. Then there is the coloring meant to make one species resemble another—as when harmless snakes take on the appearance of those that are venomous, or insects are by coloring made to resemble other insects that birds will not eat. There is, too, a sort of coloring meant to serve as signals or warnings, to enable the young to follow the mother, or to indicate that a bird is in flight toward another. The front and the back view of some birds is so different in the coloring that the merest glance shows which way the creature is flying; and many quadrupeds, especially those accustomed to live in groups, carry either a conspicuous tail or some such plain mark so that the younger ones can follow the older members in flight.

Thus color is used in a dozen ways to help animals to succeed in life, and even in plant-life there is a beginning of the same use; the blossoms do not expand and become displayed until it is best for them to be seen and found. Every one has noticed how little heed we give even to flowering plants until they are in bloom.

When we see animals brightly colored or clearly marked, we may be sure they wear their bright uniforms for some excellent reason—usually for concealment or disguise, that they may be able to creep upon their prey or to escape from them. This wonderful character is found in the lowest and highest animals, and nothing in nature is more extraordinary.

So, when you are studying a new animal, notice its coloring and marking to learn the reason and the use for the tints and the spots and stripes,—and you will soon have learned much of a new wonder in the natural world.

CONCERNING INSTINCT AND INTELLIGENCE.

Here we come upon another region of mystery. The very first and simplest forms of living things show their life by making some choice among substances that surround them. They select what is of use to them, and get rid of the rest; and in this choice is the beginning of intelligence and "instinct." The latter word is one of the hardest to understand in all our language. When a living plant or animal does certain things, and does them for reasons we are sure it does not understand, then we say it acts "by instinct." If we think the creature understands the reason for its action, then we say it "acts intelligently—and that is nearly all there is to say about the whole matter.

The child while still too young to reason, acts by instinct—it eats, and drinks, breathes or digests without knowing why. The ant or the bee, the jelly-fish, or the moth, does a hundred things by instinct; but the sly fox or the smart rat avoids a trap or a snare by intelligence; and no one can say where one ends and the other begins. It is clear to us, however, that as the intelligence—the brain—is developed, more things are done by reason and fewer by the strange power called instinct.

To take an example, who can explain why the ichneumon fly can so sting a caterpillar that it is paralyzed, and yet not killed, and so is kept in such a condition as to serve for food when the eggs laid in it by the fly shall hatch out the hungry little grubs? Men have spent thousands of years in endeavoring to understand this strange natural wonder, and we can not believe that the fly has reasoned out its action. This must have come from a higher intelligence than that of the fly or that of mankind. And there are a thousand such wonders of intelligence.

Quite as wonderful is the sense of direction possessed by various animals—the "homing instinct," as it is called. Cats and dogs, cows and horses, seem

often better able to find their way in a new place than are men. We do not know how this is done, and yet we can not believe it the result of reasoning. Certainly these animals are among the most intelligent of all, and yet they seem to us in certain ways to be exceedingly stupid.

Experiments that have been made recently show that even the most intelligent monkeys have not sense enough to reason out very simple things—such as raising a latch to open a door. After seeing it done twenty times they still fail to “get the idea.” Yet the same animals will show the greatest cleverness in catching a snake by the neck, so it can not bite them; or in dodging an attack.

We must conclude, therefore, that their minds do not work just as ours do. They are wonderfully clever in some things, and are equally stupid in others. In testing their cleverness by the things we are used to, it is fair to remember that man has used mechanical devices for thousands of years, and that they are new to animals. William T. Hornaday, of the New York Zoölogical Park, believes that the Indian elephant should be ranked first of all animals in intelligence. This elephant when convinced that men are his superiors accepts captivity without resentment, and soon is trained in Indian timber-camps to do some *sixteen* different things at the word of command—a remarkable proof of high intelligence.

The same high authority says that those who study animals' ways are apt to think those they know best the most intelligent—that Western trappers, for example, say the wolverene shows the highest powers of reasoning. Here is a story told in a recent article by Mr. Hornaday:

“My guide in British Columbia, Charles L. Smith, is by winter business a trapper; and for twenty years he has backed his reasoning powers against those of that creature of diabolical cunning and originality,

the wolverene. Rarely is a wolverene caught in a trap. Once, however, in attempting to figure out wolverene reasoning, Charlie put a quarter of venison in his cabin, left the door ajar, and planted two traps in the opening. He said: 'The wolverenes will carefully avoid those traps and stay out. Behind my cabin I will carelessly hang up in this tree the deer's head, as if I had thrown it into the discard. Wolverine will say: *'Aha! This fellow has forgotten to look out for this head. I will pull it down and drag it off.'*

"So in the spot where *Gulo luscus* would need to stand in carrying out that shrewd intention, the trapper planted a trap, attached to a pole like a well-sweep. Result: *Gulo* reasoned precisely as the trapper thought he would. He carefully avoided the traps in the doorway, went boldly to the forgotten (?) head, was caught, snatched high in air by the balanced pole, and when the trapper returned from his line he found his implacable enemy hanging high, and dead as a wedge."

From this it would seem that the animal must have reasoned just as the trapper believed he would—unless the wolverene happened to find the deer's head first?

There is no end to the questions we might ask about instinct and intelligence, for the right scientific study of these has hardly more than begun. It is not many years ago that everything animals did was called "instinct," and some able men even maintained that all animals were only automata—that is, mere self-moving machines without power to think, reason, or feel.

THE WONDERS OF NATURE ARE EVERYWHERE.

We must get rid of the idea that the chief marvels of the world are only to be found in distant climes, on lofty mountains, in remote deserts, or on the open seas. Study the things about you, and you may discover marvelous truths in your own home or doorway. Try to see how the commonest domestic ani-

imals act in various weathers. It is said that the cat, the goat, the rats and mice all seem to foretell rain by unusual actions, and that dogs refuse meat before the coming of rain, while pigs pick up straw and leaves before cold weather—as if to make a warm bed. Observe them and see. Get acquainted with the common insects, and learn their ways. The building of the enormous Panama Canal has been made possible because it was learned that malaria could be prevented if mosquitoes were kept from biting the workers.

If you live by the sea, you have a world of marvels at your very door, and may study it all your life without beginning to exhaust its wonder-stories. Every shell has a story to tell, each pool abounds in life, and with a little help from books you may make most interesting discoveries.

Every field and garden, every shrub and tree, is interesting in itself, and is besides the dwelling-place of countless creatures who lead lives different from one another and from all others. Watch and think, and you may add much to the knowledge of the world—as Charles Darwin did when he studied the life of the common earthworm found in every square foot of soil. Luther Burbank, of California, has so studied and worked over his own home-grounds that the greatest scientific men are glad to cross the ocean simply to see the wonders he has brought about.

AN EXAMPLE OF A LITTLE SCIENTIFIC STUDENT.

Here is an interesting item, raising a great question, and the whole matter came about through an experiment that may be tried in any home:

“Do plants think?” asked a St. Mary planter. “Have they powers of reason or any way of determining what is going on around them?” The questions seem rather fantastic, I admit, but they are prompted by some very curious observations made at my home only a few weeks ago.

“My daughter, who is very fond of flowers, has a morning-glory vine growing in a box on her window ledge. While watering it recently she noticed a delicate tendril reaching out toward a nail in the side casing. She marked the position of the tendril in pencil on the wood, and then shifted the nail about an inch lower. Next day the little feeler had deflected itself very noticeably, and was again heading for the nail. The marking and shifting were repeated four or five times, always with the same results, and finally one night the tendril, which had grown considerably, managed to reach the coveted support, and we found it coiled tightly around it. Meanwhile another bunch of tendrils had been making for a hook that was formerly used for a thermometer. Just before it reached its destination my daughter strung a cord across the window sash directly above. It was a choice, then, between the old love and the new, and as a morning glory always seems to prefer a cord to anything else, it wasn't long in making up its mind. In a very few hours the pale, crisp little tendrils—which, by the way, convey a surprising suggestion of human fingers—had commenced to lift toward the twine. Next day they reached it, and took such a firm grip that I don't believe they possibly could have been disengaged without breaking the fiber. Scientists are no doubt familiar with such phenomena, and, if so, I would be very glad to learn whether they have formulated a theory on the subject. To me it seems simply inexplicable.”

What could be more interesting than to find out, by trying some such experiment in different ways, whether the morning-glory vine really can choose between one support and another—and whether it will, between the same two things, always make the same choice? One who could find the answer to this question, and prove it, would do much toward solving a great mystery of nature.

CONCLUSION.

We have now glanced here and there throughout the world of plant and animal life, and have learned the manifold uses mankind have made of these fellow-creatures. We have seen that this old, old world of ours is yet in spite of its age a little-understood home. Every day brings new knowledge, and every bit of new knowledge helps to make our lives better worth living. To all those who have helped in the knowledge of the world and its creatures each of us owes a debt of gratitude greater than can ever be paid; but if we feel grateful, and would do what we can to repay all others have done for us, we should each try to learn what we can, in the hope that we also may have added something to the treasures of knowledge handed onward to succeeding generations.

One can hardly give a more striking example of what a little right thinking may bring about than the old, old story of James Watt and the boiling tea-kettle on his mother's fire. The boy's question to himself, "What lifts the lid of the kettle?" was the beginning of the steam-engines that have made our whole world seem man's kingdom.

In our own days, it seems likely that progress toward easier and happier ways of living will come from a closer study of nature; and any boy and girl whose interest in nature is once aroused may become one of those to whom all mankind shall owe a debt of gratitude.

CHAPTER XXXV.

Ocean Life.

CREATURES THAT LIVE IN THE SEA.

HE ocean, as you know, covers fully three-fifths of the surface of the globe on which we live; and it is teeming with life from top to bottom, from shore to shore. Fishes and living creatures of all shapes and sizes swim and move about within its depths; some of them of such beautiful colors that one wonders that they live so far from the sun's rays; others of them so hideous that one can scarcely look at them without shuddering—without thinking how terrible the fate of those who fall into their power, in a watery grave.

The light of the sun penetrates only a few feet below the surface of the ocean; below that, all is darkness, unending and eternal. The waters at these great depths are also icy cold, so that any warm-blooded animal, even if it could live there otherwise, would soon die from cold alone. Then, the water so far down exerts a tremendous pressure; miles of water are pressing upon each square inch of surface, so that pounds and pounds of compression are brought to bear upon the body of any animal living in these regions. Deep-sea creatures must, therefore, be especially constructed to live at all under these peculiar conditions.

SOME FISHES CARRY LANTERNS.

Many of the fishes which swim about at these great depths are provided with phosphorescent lights, either in their heads, or in rows along their sides, seeming like a row of little port-holes or dark-lanterns. These

lights enable the creatures to find their way about; but are also a menace to them, inasmuch as they attract other fish by reason of the brightness. All deep-sea fish are cold-blooded, and need not maintain themselves at a higher temperature than the medium in which they live, in order to support life. Again, the very structure of the deep-sea fishes is peculiar. As before said, the pressure here is very great; so that fishes which live on the surface of the ocean can not descend below a certain depth, or they will be crushed to death by the pressure of the water. But the creatures that live at the bottom of the ocean are especially formed to sustain and withstand this enormous pressure; they have no bones, such as other fishes have, and the fluids inside their bodies are at the *same* pressure as those without. Thus the pressure is equalized. But when such fishes are raised to the upper levels of the ocean, where the pressure is not so great, they in turn die because of the pressure from within. Fishes that live at the bottom of the sea, when brought to the surface are always dead, and show signs of what we may call an "explosion," caused by the internal pressure.

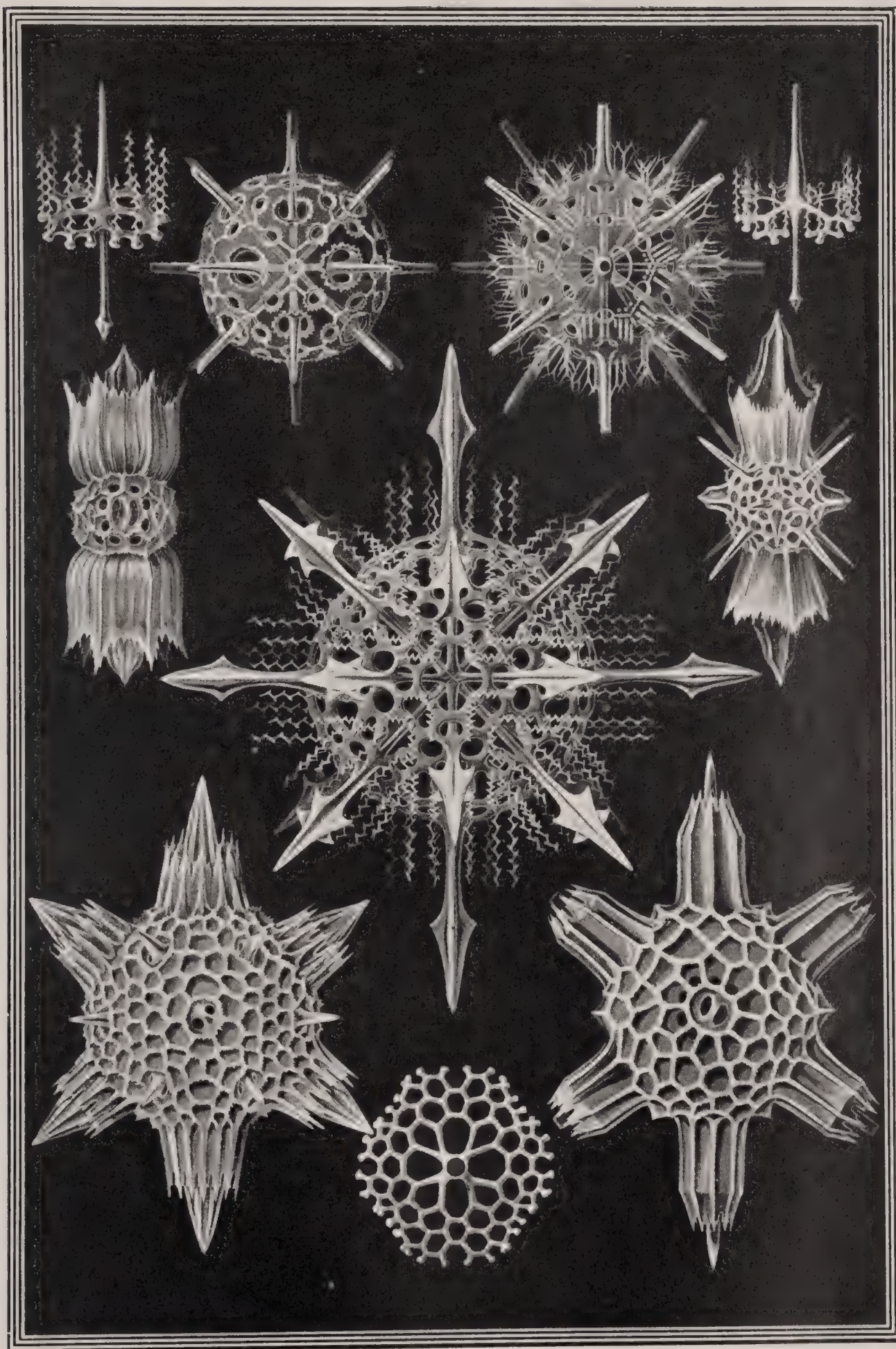
"No one," says Dr. Hanna Thomson, "who from a ship's side sees some moving thing far down in the water, can escape shuddering at the thought of falling into those cold depths below. Science, however, has penetrated these dark, still abysses, and finds that they abound with life. But such life! Worse than the great octopus which swims near the surface, many of the abysmal forms have large movable jaws with rows of teeth all pointing backwards, making escape impossible when once any creature is caught by them. . . . In all that living marine world, there is not a trace of goodness. All fishes are murderers and cannibals, and as in fresh-water big trout relish eating small trout, so in the wider waters of the ocean, woe to the small fry when a larger father or brother

catches sight of them! . . . Only among those animals which originally used to tread the solid earth, and then took to the sea—like the whale, seal and walrus—is there a sign of any falling off in all-devouring selfishness, because they are mammals, and hence show affection for their young. Otherwise they live where they have to encounter the hideous swordfish, or their own relative who has been transformed into the cruel grampus. On the other hand, any shell always affords food for reflection. What does a shell always mean? A shell is nothing less than an elaborate hiding place constructed by its animal, into which it can retire for the saving of its life from its living foes. But scores of these enemies then provide themselves with drills, awls and similar contrivances which bore holes in the shells through which the unhappy recluses are gradually sucked out. . . .” (*Some Wonders of Biology*, pp. 204-7).

These big fishes are not the most numerous inhabitants of the vasty deep, however, for, as Lord Kelvin has pointed out, nearly all the animals at extreme depths belong to the sub-kingdom of the protozoa; and having no special organs for nutrition, they absorb nourishment through the whole surface of their jelly-like bodies. Most of these animals secrete mineral matter and build up exquisitely-formed skeletons, some of silica, some of carbonate of lime.

Several years ago, the Bay of Biscay was dredged over a wide area, at an average depth of 2,435 fathoms (14,610 feet), giving a fair idea of the surface-layer of the bottom of the sea at this depth, and in this locality. Under the microscope, the surface-layer was found to consist chiefly of entire shells, large and small, and fragments of shells mixed with a quantity of calcareous matter in fine particles, a little fine sand, and many spicules (small spikes) and fragments of spicules, and sponges, and similar low forms of life.

At great depths, shell-fish, or mollusca, are rare,



DECORATIVE FORMS OF MINERAL SKELETONS.—These are left by certain minute Sea Animals when the softer parts are removed.

though at lesser depths they can be found in large numbers. As a rule, the deeper we go, the paler are they in color; and many of those living at the greater depths are destitute of eyes—these organs not being needed in the great darkness at the bottom of the ocean. It is thought that perhaps a large area of the lower strata of the ocean is lighted by a species of phosphorescence, due to certain light-giving animals living at these great depths.

THE LIFE OF THE JELLY FISH.

One of the commonest objects of the sea-shore is the jelly-fish, which sometimes becomes of great size; and it is one of the most interesting objects upon the shore. In spite of the fact that its life is so short—it is born, lives and dies between spring and winter—it grows to a size sometimes of two feet and more, seeking constantly new food, which it takes in and devours with avidity. These fishes have nerves and eyes of a sort; they produce young; they have a complex body, sometimes of great beauty.

SEA HORSES AND “SHOOTER FISH.”

There are all kinds of fishes in the ocean, great and small, dangerous and harmless; some of enormous size, others so fine and delicate that they appear quite transparent, like a thin film of jelly, floating sideways in the water. Other fishes are capable of giving one an electric shock, when touched; some tiny ones resemble (in the upper portion of their bodies) horses, having horses' heads—like that of the knight on a chess board—and a fish's tail, and these are known as “sea-horses.” They are almost the only fishes which show any affection for their young, and, oddly enough, the male is the one who takes charge of the young from birth, and in his tail is a small pouch, in which the female—who has no pouch—lays her eggs.

Again, there is the wonderful “shooter-fish,” which

inhabits the seas of Japan and the Eastern Archipelago. When kept in confinement, these fishes may be seen to shoot drops of water from their elongated jaws, and to hit flies and other insects which attract their attention. They have been observed to strike their prey with unerring aim at distances of three or four feet.

THE OCTOPUS AND THE SWORD FISH.

Again, there is the octopus, with its small body, its wicked eyes, its innumerable waving arms, provided with suckers, which hold its prey until it is drawn to the mouth; and it has the ability to inject an inky-black fluid, when frightened or pursued by its enemies. There is the swordfish, with its long, saber-like nose; and the sawfish, with a double-edged saw—two to three feet in length, jutting out in front. There are fish which can glide or fly considerable distances through the air—these and many other curious fishes are to be found in the waters of the greatest seas.

SCAVENGERS OF THE OCEAN.

Crawling along the bottom of the ocean are the Crustacea—the crabs, lobsters, prawns and shrimps which are eaten by a large number of persons and are considered delicacies. These creatures have eyes at the end of long stalk-like projections, and are often very unpleasant to look at. They are largely the scavengers of the ocean, eating anything which comes near them.

Many of the ocean's wonders may be seen upon the sea-shore. Charles Kingsley, in his book *Glaucus*, has beautifully described some of these, and I can not do better than quote from what he says. Wandering along the sea-shore, one encounters many curious objects; here, there, everywhere, is life—and life of a curious character, unknown to us. Thus:

“What are these striped pears? They are sea-anemones . . . the snake-like anemones. They have

been washed off the loose stones to which they usually adhere by the pitiless roll of the ground swell; however, they are not so far gone but that if you take one of them home and put it in a jar of water, it will expand into a delicate compound flower, which can neither be described nor painted, of long pellucid tentacles, hanging like a thin, bluish cloud over a disk of mottled brown and grey. Here, adhering to this large whelk, is another, but far larger and coarser. It is *Sagartia parasitica*, one of the largest British species; and most singular in this, that it is generally found adhering to a whelk, but never to a live one; and for this reason: the live whelk . . . burrows in the sand in chase of hapless bivalve shells, which he bores through with his sharp tongue (always, cunning fellow, close to the hinge where the fish is) and then sucks out its life. Now, if the anemone stuck to him, it would be carried under the sand daily, to its own disgust. It prefers, therefore, the dead whelk, inhabited by a soldier crab, of which you may find a dozen anywhere as the tide goes out; and travels about at the crab's expense, sharing with him the offal which is his food. Note, however, that the soldier-crab is the most hasty and blundering of marine animals, as active as a monkey, and as subject to panics as a horse; wherefore the poor anemone on his back must have a hard time of it; being knocked about against rocks and shells, without warning, from morn till night and night to morn. Against which danger kind nature has provided by fitting him with a stout leather coat, which she has given, I believe, to no other of his family."

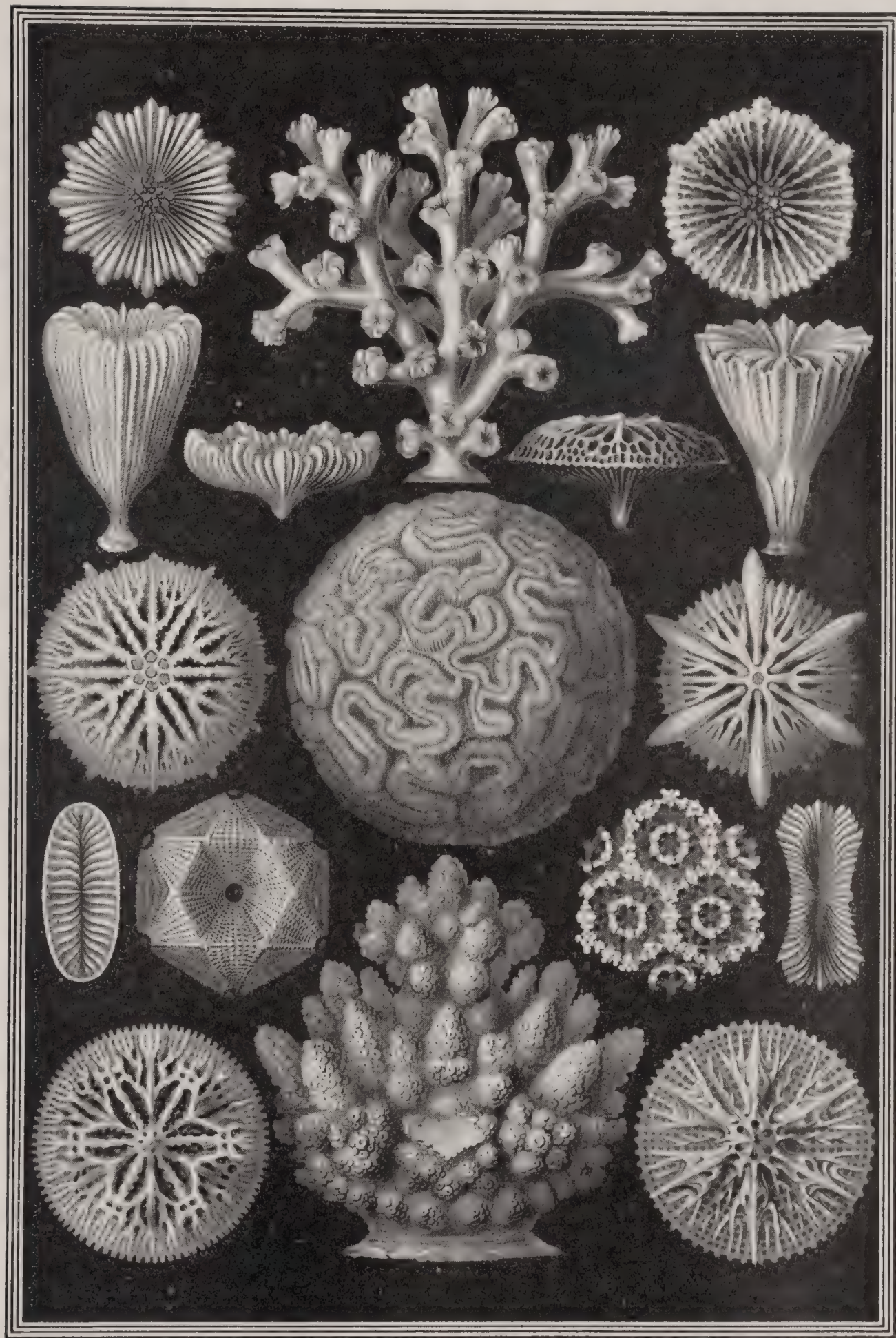
THE CORAL INSECT—ARCHITECT OF CONTINENTS.

There are many other equally curious creatures to be found on the sea-shore. There is the *Synapta*, which, when caught, has a strange habit of self-destruction, contracting its skin at two or three different points, and writhing until it snaps itself into

“junk,” as the sailors say, and then dies. There are the curious milk-white slugs which neither eat nor breathe between tides, but seem to hibernate, like some animals. They have the power of casting up their entire insides at will. There are tiny saucer-like things of the thinnest ivory, containing in their centers a milk-white crust of stone, pierced into a thousand cells, each with its living architect within. These are of two kinds: in one the cells radiate from the center, giving it the appearance of a tiny compound flower; in the other they are crossed with waving grooves, giving the whole a peculiar fretted look. And upon it you will find a red wart-like body, which is the coral insect—the most famous of all insects of the sort, which in the tropics are the architects of continents and the conquerors of the ocean’s surge. From the bare rocks above high-water mark, down to abysses deeper than ever plummet sounded, is life, everywhere life; fauna after fauna, flora after flora, arranged in zones, according to the amount of light and warmth which each species requires, and to the amount of pressure which they are enabled to endure. The crevices of the highest rocks, only sprinkled with salt spray in spring tides and high gales, have their peculiar little univalves, their crisp, lichen-like seaweed, in myriads; lower down, the region of the *Fuci* (bladder-weeds) has its own tribes of periwinkles and limpets; below again, about the neap-tide mark, the region of the *Corallines* and *Algæ* furnishes food for another species which grazes upon its watery meadows; and beneath all, only covered at low spring-tide, the zone of the *Laminariæ* (the great tangles and ore-weeds) is most full of all of every imaginable form of life.

THE OCEAN MORE WONDERFUL THAN THE LAND.

And if this is true of the sea-shore, how much more true is it of the ocean itself—with its countless varie-



ORNAMENTAL FORMS OF THE FRAMEWORK OF THE CORAL ANIMALS.—The three largest, in the center, like a tree, a globe, and a basket of flowers, represent the skeletons of limestone left by colonies.

ties of fishes and living things—beautiful and hideous, great and small, comic and wonderful! If the land swarms with life, the ocean may be said to be a thousand times more crowded, and by creatures which of course find it as natural to live in water as we do in air!

CHAPTER XXXVI.

Some of Nature's Mysteries.

E shall try to give young thinkers a clear idea of what naturalists mean by their phrase “struggle for existence”; why they insist that such a struggle is going on everywhere and always; and how it has affected the world of living things—including ourselves.

It has sometimes seemed, to those who have not examined the matter carefully, that this is a hard doctrine; that it makes out the world to be—and always to have been—a place of death and cruelty; a place where a defect meant defeat, weakness was always the prey of strength and cleverness, rivalry the rule of life, and where the highest virtue was the ability to get ahead.

And indeed, when it is looked at in a certain way, all this is true. All that can be said about it is that there could not be any world where such words as chemistry and physics, plant and animal, mean what they do to us, in which the matter complained of could be different. Our globe is a mere speck in a universe whose limits are terrific in their vastness; and its form, structure, and everything about it are governed by the great natural laws which control millions of other worlds as well as ours.

THE REIGN OF UNIVERSAL LAW.

[This, then, is the first thing to remember, that our earth and all its belongings act under laws and influences as broad as the immeasurable universe.

Did you ever see a vast wave come sweeping upon a stony beach? As it rushes up the gravelly slope thou-

sands of pebbles roll with it over and over, then pause and rush back again until the water has left them. Each pebble turns and travels just like every other under the irresistible drag of the wave, for its power covers all the thousands of stones alike. So our planet obeys the general law just as every other planet does.

But as the great wave is made up of innumerable drops, and of incessantly varying amounts of weight, pressure, push and pull, so the universal law consists of innumerable laws and influences which we call the necessities of chemical affinity, of electricity, of light, heat, motion, will, and so forth.

Now keep your thinking-cap on tight a minute or two longer, because I want you to crowd firmly under it a few more big ideas.

The grandest fact about these great laws that govern us, whether we will or no, and perhaps the only one in which they agree (and thereby show themselves only phases of one universal government), is that each acts as if there were no other. Each is on duty every instant, never losing the smallest chance to effect its object, nor ceasing until that object has been attained or else has been set aside by some stronger influence. Can you conceive of an unsupported object not falling to the ground because "gravitation" is not attending to its business? Now it appears that in spite of the infinite variety among these influences, all of them, without exception, are striving toward a single end or object.

What is this all-important object? It is the simplest thing in the universe—to bring everything into a uniform condition, to reduce all things to a level, a state of complete rest, an even balance or equilibrium.

OPPOSING FORCES.

But every force in nature seems to have to contend against an opposite method of working. One force is bent upon heating, but finds another bent upon

cooling; one force would bring everything to a center, another would send everything flying away from a center; and so on. So here we have at the very basis of nature (that is *law*, and all that it controls) a gigantic struggle, of which that we shall presently see among the living things on our earth is only the faintest echo.

In truth, it is only because these vast cosmic* forces have become pretty nearly equal, and able, on the whole, to hold each other in check, that we have an orderly universe instead of chaos, and an orderly world instead of a shapeless star-mist; yet because they are not quite balanced, but are still able here and there to get the better of one another in respect to our planet, it happens that the earth is not doomed to such a motionless death as has overtaken some planets.

Let us look for a moment at one example of natural activity, not only for its own sake, but because of its influence on plant and animal life. General uniformity nearly exists at the poles of our earth, where the heat of the sun glances off and the cold of space absorbs all the heat that escapes from the globe so fast that the ground can not keep warm enough to prevent all the water freezing and staying frozen; whereas at the equator the sun-rays strike straight down, sink into and heat the atmosphere and surface, so that ice never forms.

THE CAUSE OF THE WINDS.

What is the consequence of this difference? Here are two opposite states of things on the same globe, only some six thousand miles apart, and every physical law instantly goes at work to equalize them. Air is so made that when it has a certain degree of warmth it soaks up moisture. Having done so it becomes lighter, and floats upward, while dryer, cooler air

*There is no reason why we shouldn't use unfamiliar words like this, now and then, for you may find them all in any good school dictionary, and it will do you a world of good to look them up.

rushes down to satisfy its lack of warmth and moisture. The currents of air formed by this interchange we call winds, and the revolution of the earth causes them or a part of them, to drift poleward, or against mountain tops, whence they grow so cold they can no longer carry the moisture, which is squeezed out of them by contraction.

Now begins another phase. Gravitation is on duty here as elsewhere. It pulls the rain down, and insists that the water shall make its way with haste to the low places—seas and lakes and ponds; and shall carry with it everything it can move, loosening avalanches, rolling rocks and pebbles (which often get crushed or worn in the process), floating grit and mud, dissolving minerals out of rocks, utilizing all ways to get materials of high places down into the low places. Heat and cold cracking and wedging things apart, crumbling and melting rocks and earths, help in this universal effort to tear down the hills, fill up the valleys and make the whole world level; and as fast as the stuff comes down gravitation sorts it out, and chemical agents recombine it into new and more usable forms.

THE MAKING OF THE EARTH.

The result is that finally, instead of a globe of smooth granite or lava there is one torn to pieces by volcanic upheavals, earthquake shifts and the grinding and sorting action of water, and consisting of a great variety of rocks, some much mixed in composition, and an equal variety of loose earths or soils. Thus the see-saw effort at uniformity has resulted, so far, only in the greatest diversity. On top of this there occurs in most parts a change of local climate twice a year—winter alternating with summer, or a wet season with a dry one.

It was, then, to a world of incessant and often violent change that living things were introduced; and doesn't it appear probable, when we remember how

sensitive all living things are, that they would be influenced and modified by their variable surroundings?

WHEN LIVING THINGS BEGAN.

In obedience to some act or demand in nature which we do not understand, life appeared—just when or how no one knows. It began in the sea, and plants preceded even the very simplest animals. At any rate, after a time plants covered the earth in thousands of different kinds, as various as the conditions of soil and climate in which they grew, and so numerous that no spot on the earth where plants could exist remained uncovered.

Everything goes to show that the abundance of plant-life which now hides mountains and valleys under great forests, carpets dales and prairies with a rich growth of flowering herbage, and even tries to shield the desert places under wiry grasses and thorny shrubs, did not come into existence suddenly, or in the diversity we see, but, on the contrary, has been made by very slow and gradual increase and change through an enormously long period of time; and all the time the effort of the great gardener, Nature, was to make each plant produce as many young plants to come after it as possible, so to cover the land to the greatest possible extent.

Now when every plant felt, as it were, this command, and devoted all its strength and energy to obeying it, as though it were the only plant and the only kind of plant on earth, it takes but a moment's thought to see that it would not be long before there would be trouble from overcrowding.

At first what land appeared above the sea was naked rock to which could cling only some lichens; but gradually the hard surface was softened, soil formed and was swept by rains into wet hollows where dense mosses began to flourish. And right here we get almost our first glimpse of the second great rule of

plant-life (and of the animal-life which presently was to follow). The first and highest rule was to keep alive in order to multiply and spread; the second immediately followed it, namely, that every plant (and animal) should be quick to take advantage of every change to better itself. In other words nature required that her children should not only exist and be numerous, but that they should develop and improve. This second law may be called the *Law of Adaptation*; and to the ability of plants and animals to meet its requirements is mainly due the vast abundance and delightful and useful variety in the world today, as compared with the barrenness at the beginning; and also the success of those kinds which have flourished most.

ADAPTABILITY A NECESSITY OF LIFE.

Adaptation, adaptability, the power to change as the surrounding conditions changed, the ability of an organism to suit itself to altered circumstances, has, then, from the very beginning of life on the earth, been the test of value and the key to success in each kind of plant or animal.

Both these important qualities—vitality and adaptability—were and are required much less of some creatures than of others. For example, many simple, minute animals and plants still inhabit the oceans, which are little if at all different from those whose imprints are found in the oldest rocks. This is because the ocean itself is practically the same now as it was at first, and there has been nothing to excite change in these very simple forms, which are much less sensitive than are the more complicated ones, such as molluscs and fishes; yet even some of the latter have remained with almost no change for perhaps millions of generations.

But no such uniformity is to be found on land in the open air, anywhere between low-water mark and the mountain crests. Sunshine and frost, wind and

rain, earthquake, lightning and flood, are roughly aiding day by day the steady work of the chemical agents supplied by air and water in changing the face of the earth. Moreover it must be remembered that the central belt of the earth is in a perpetual summer and there is a more or less regular increase of coolness in climate as one goes north or south from the equator toward perpetual winter at the poles; also that scattered about the earth are ranges of mountains whose tops are arctic in their coldness, other spots which are hot, dry deserts, or vast swamps, or lofty tablelands. In each of these regions the amount of warmth, cold, water, etc., differs from that in each of the others, and in all of them great and sometimes rapid changes of climate have taken place in the past and continue to take place.

Remembering these facts, is it any wonder that species (kinds) of plants must have adaptability in order to thrive? And when many species are trying to flourish in the same region, isn't a struggle certain?

This struggle will take many forms, but in plants these forms will be, as a rule, of two kinds: first, against difficulties in situation, soil or climate; second, against the competition of rival plants.

LIMITATIONS PLANTS MEET.

There is, for example, the matter of room. A violet, or herb-robert, uses only a square inch or so of surface, but gives out hundreds of seeds, and the expectation is that every seed will find a lodging-place, sprout in turn and send forth its own hundreds of seeds. Only a few years would pass before the whole world would be covered with violets and herb-roberts, and they would come to a fight as to which would crowd the other out. Take the other extreme—a huge tree like a sturdy oak or pine, or one of the grand elms that make our eastern village streets so beautiful. The crown of branches is as big as a church, and it may

easily be a hundred feet from side to side of the circle of spreading roots. Tens of thousands of seeds are scattered abroad by each tree or pair of trees. Should even half of them take root, how long would it be before an unbroken forest of oaks and pines or elms shaded the whole continent?

As a matter of fact, however, many things interfere to prevent a monopoly by any one kind of herbage or shrub or tree over more than a small space. Certain great limits are set by climate. Tropical plants can not grow north of a certain latitude, nor arctic forms south of a certain line. A lofty mountain-range or table-land will form, by its cold summits, a wall impassable by the warm-climate vegetation of the lowlands at its base; while, on the other hand, the trees and herbage of the mountain tops can not spread to the warm valleys any more than those of a region where rain is plentiful can pass into or over a desert-belt, such as the Sahara or the arid country along our Mexican border. Oceans separating continents and great islands restrict to each its peculiar flora, so that almost none of the plants or trees of any one continent or of big islands, as Australia or Madagascar, are to be found elsewhere, except some very low and ancient forms, such as mosses. This has been so since plant-life on the earth began. The land-area at first was very small. As it gradually enlarged, by the elevation and broadening of the continents, plants spread to occupy the drying places, but the various kinds adapted themselves to the conditions in which each found itself, and could not live beyond where those prevailed. None of the more highly organized plants, then, could take possession of more than a part of the earth, because beyond certain limits the winter was too cold, or the soil too dry, or something else was fatal to its seeds.

But while these large and ancient groupings of plants have usually been set apart by such natural

boundaries as oceans or deserts or ranges of high mountains, there is going on within each, all the time, a fierce warfare along invisible boundaries and with constantly swaying results. In the battle for life among the plants there can never be any decisive end.

The outcome of this scramble for room and the means to live and grow, which naturalists have called the *struggle for existence*, is incessant variation in form, and the disappearance from time to time of varieties and species, and even of whole families, which were starved out or crowded to death or otherwise worsted by new species or groups better fitted to survive.

THE BATTLE FOR LIFE AMONG PLANTS.

No one ever made a garden in a wild spot without seeing an example of this battle, and grumbling at it. His vegetables and flowers thrive amazingly in the new soil, but how promptly also the "weeds" rush in—the hardy wild natives of the neighborhood, habituated to the qualities of the locality and rejoicing in this fresh garden spot. One must pull, pull, every day, or the strangers he has planted will be choked to death in a short time.

What is it a plant needs in order to thrive? It needs air, from which to get its main support, carbon, extracted from the carbon-dioxide in the air by the green matter (chlorophyl) in leaves; soil where it may anchor itself and whence it may draw the mineral food which is changed by digestion into the substance of its stem, leaves, flowers and fruit; and water, by which this food is carried into all its tissues, and from which it takes additional nourishment.

But all three (air, soil-elements, and water) have changed in quality repeatedly as time has gone on. In the early days of the world the atmosphere seems to have been damp and murky, saturated with carbon-dioxide gas and with little sunlight reaching the

ground. All the larger plants were spongy, huge-leaved forms, such as tree-ferns and cycads, which grew in mossy bogs and became loaded with carbon. Hence when growth upon growth filled these swamps with peat, which was finally overlaid with sand and mud and pressed into a rock-like mass, that mass became almost solid carbon or coal. Such a thing could hardly happen now.

CHANGES IN PLANT LIFE.

But gradually the washing by rain and the continual subtraction from the air of carbon-dioxide by these plants of the Coal Period (which replaced every atom they took by an atom of new oxygen), steadily purified both the atmosphere and the fresh waters. Along with this change in the chemical character of air and water went on a change in the character of the world's vegetation. The old carbon-stuffing coal-plants, as we know by an examination of fossils in the rocks, studying them strata by strata in the order in which they were laid down from the oldest to the more recent, were gradually replaced by more and more improved and more and more varied kinds adapted to the constantly clearing atmosphere and to a dryer and more sunny state of things; and we can trace the changing forms in ever-broadening variety up to the present patterns in herbage and tree.

No one influence upon plant-life is so strong, however, as that of the soil on which it feeds. Where this is rich in nutriment the plant grows large and strong, bearing many and vigorous seeds; where it is poor the opposite is the case. Thus plants of the same sort will differ in health and vigor according as they are half starved or well nourished. This will make a difference in size and in the number and perfection of seeds, as any one may prove in his garden by starving one end of a bed of flowers or vegetables and giving the other plenty of watering and manuring.

Farmers have learned that to raise one sort of crop year after year upon the same piece of ground is to invite failure. The corn, oats, tobacco or whatever it is, soon uses up all, or nearly all, of that special material in the soil which the particular crop requires. The same thing happens, only more slowly, in nature. Plants grow weak which stay too long in one spot, and so can not resist their stronger neighbors whose own special nutriment is still abundant there. Hence gradually wild plants, as well as cultivated ones, must change places of growth.

In this connection two things must be noted: first, every such change of place, by introducing some new influence, tends to promote a slight helpful alteration in structure; and, second, it affords a capital reason for the universal effort of plants to scatter seeds as widely as possible.

IMPORTANCE OF SCATTERING SEEDS.

Just to produce a great number of seeds would rarely answer the behest of nature to multiply and spread the species. If all simply sank to the ground around the parent stem, that would be of small benefit to the species (which is what nature is looking after), for in most cases the place is already crowded and the soil is impoverished. If a species is to spread and thrive its fruits must manage to find new ground elsewhere; and therefore, special arrangements have been acquired by most plants for scattering the seeds and giving them a chance to get started in new soil. Some of these arrangements are very curious and complete.

One of the most familiar is that by which seeds are sown broadcast by the wind. In late summer the meadows are dotted with purplish tufts of thistle-down and feathery balls of dandelion-heads; and the youngsters, rolling about in the warm, dry grass pluck them and, holding them before their lips, blow away puffs which float off out of sight, the children never

thinking that each tiny floater is carrying a seed which will gradually settle down and perhaps plant a new dandelion. Those great poplars which shade American western streams are called cottonwoods, because, when the breezes of early autumn cool us, the air all about the trees is filled with tufts like snowflakes, each carrying afar the seed of the trees. It is no wonder that the cottonwood is to be found all over the country. Cotton itself is only the long pappus, as botanists call it, by which in the wild plant the seeds were to be lifted and wafted away by the wind to new places of growth. The maples give other familiar examples. Supported by their dragon-fly-like wings, the "keys" of the maple, each carrying a seed, drift for long distances. Nothing is prettier on a bright October day than to stand near a tall and stately tulip tree and watch hundreds of little tulip-keys go shimmering off through the sunny air, whirling and sparkling like winged gems. Similarly, the seeds of the lime, birch, ash, and many other hardwood trees, may be carried by their parachutes far from the branches where they were born, and given a chance to drop and take root in some distant and perhaps better spot.

HOW SEEDS TRAVEL.

There are other methods of travel. On open plains thousands of seeds are pushed, rolled, and swept along the ground for great distances; sometimes whole plants are torn up and bowled across a whole country, as in the case of tumbleweeds, to get lodged at last against some obstruction and there take root again from the first time a hard rain softens the earth.

Most seeds will float, and every stream carries them down its current in autumn to plant its banks with greenery and shade. Everywhere along low seashores in the tropics stands a dense jungle of bushy trees called mangroves. There are hundreds of miles of them around the margin and on the islets of the

Gulf of Mexico and the Carribean Sea; wherever an oyster-bed or a coral-reef, or a mud-bank at the mouth of some sluggish river, grows until it reached the surface, there mangroves seem to spring up as if by magic. But there is no magic in it. They rise from seeds that have wandered miles from other shores. These seeds are contained in long pods—one in each pod—shaped like big cigars, which drop from the parent tree into the sea-water and there, being heavier at one end (the root end) than at the other, float upright. Should one drift over a mud-bank still covered at high tide by eight inches or so of water, the lower end will be caught, and if it is not soon dislodged by a storm will take root. So these pods will sprout and grow, will bind the oozy mud and sand together by a network of roots, which catches drifting stuff of all sorts, and a wooded islet will begin. No wonder these mangroves spread far and wide and serve an important purpose in turning coast-swamps into useful lands. The rich prairies of the delta of the Mississippi would hardly have been possible as farms or pastures had it not been for them during centuries past.

HOW THE BIRDS AID THE PLANTS.

Then there is a large class of seeds which have little means of traveling themselves but get themselves carried. Such are the troublesome burrs, beggar-lice, stick-tights, agrimony, and other prickly and hooked seeds which make us grumble as we look at our clothing after an autumn ramble. We throw them down, perhaps a mile or so from where they were caught, and so do just what nature has intended; for seeds of this kind are made to catch and be carried far and wide in the wool or hair of wandering animals. Similarly the sticky fruit-pods of the pond-lily attach themselves to the feet of ducks and of wading birds, which carry them to be washed off in the next stream or pond, where they take root. It is believed that the vegetation of

islands has been mainly introduced in this and other ways by birds.

Birds, indeed, are very important agents in enabling plants in general to spread. All seed-vessels, nuts and so forth, are "fruits" to the botanists; but what we usually call fruits are seeds, or groups of seeds, about which there grows a soft, juicy, edible pulp. All such are attractive when ripe to many birds. Indeed, it is thought that the fragrance and the usually striking color of fruit have been slowly brought about because birds have liked it, and because it was helpful to the trees and shrubs and plants that bore it that birds should eat it. How helpful? In this way: A robin that eats a cherry, for example, is likely soon to fly away. The pulp is quickly digested in the bird's stomach, but the hard "pit" (the seed) passes on unchanged through the intestines and is presently dropped. The same thing happens with other fruits. If such a cast seed falls in a favorable place a tree or bush of the same kind springs up there, and the whole plan has succeeded; and it is almost alone by such means that a large number of kinds of plants have secured their wide distribution—poison ivy for instance.

WHICH PLANTS SUCCEED.

Now you will see at once that when plants depend upon the uncertain, almost accidental, means of maintaining themselves and their races which have been outlined, and each plant is only one of a crowd fighting for its share of room and sunlight, water and food, where there is by no means enough for all, any acquired strength or advantage is important. To be able to grow in fresh soil is an advantage—so much so that a newcomer might even flourish better than the native plants among which its seed had dropped. It might, also, in the new spot, even though only across the field from its parent's place, find itself planted in a richer soil, grow bigger and stronger, and

make more vigorous seeds than the parent stock. Thus, as you see, transplantation of seeds increases the chance of improvement; and it also increases the chance of varying, by bringing to bear upon the growth new influences of various kinds.

Suppose, for instance, a plant more favorably situated than its fellows is taller, and bears a berry which, getting more food and sunlight, is a little fatter than those of the others, and has a tinge of red. Such a fruit would catch the eye of a bird and be taken more quickly than the paler ones beside it. If it, in turn, got planted and grew, it would impart its vigor to the seedling and the berries borne would be likely to be still more reddish. Let this process go on and there would be always a steady progress of improvement toward finer and more attractive fruit, while the old, neglected, pale stock would steadily lose place in the race. Finally the old stock would die out and a red-berried kind would have taken its place. We would say this was a case of *evolution by natural selection*; and the agent would be the birds who continually selected the larger, redder berries, and by dropping their seeds here and there continually favored the growth of a variety more and more likely to produce each season berries a little fatter and a little redder than their parent plants produced. The bird was only seeking the best berries, but the plant profited. Neither, of course, had the least idea of what was going on.

PLANTS AND THE SOILS THEY NEED.

But the soil varies everywhere not only in being poorer in some places than in others, but in what it contains. It is formed of rocks which have been decomposed by the action of the air or water or frost, or have been ground into dust by glaciers or grinding ice or river currents, and therefore it has the same mineral character as the rocks themselves. Thus in

a region, like the central Mississippi valley, underlaid with limestone, the soil and the waters upon and under the ground contain a great deal of lime, whereas in a region of sandstone or granite there is little lime in the soil. Hence it is natural to find, as every one knows we do find, different sets of plants on one kind of soil than on another; and when we look closer we notice that many plants, large and small, grow only in certain small regions, or at certain heights above the sea, or in particular valleys, or only on clayey fields in shady spots and not at all in open sunny places. These soil-influences are naturally powerful, and to them are due a great many, perhaps most, of the varieties among the plants of each continent. Some kinds are extremely numerous, hardy and widespread; others, crowded out by these hardy, vigorous, competitors, are uncommon and confined to small districts, where they are so sensitive to some harmful substance in the soil or feature of the climate that they can flourish only in particular places.

Each and all of them, nevertheless, are striving with all their might to multiply their numbers, and thus increase the space their species cover, by producing and sending broadcast a great number of young—some, as the poppy, thousands of seed—and at the same time to get ahead themselves. As Grant Allen has said: “Every one of them is fighting against the other for its share of light and food and soil and water. The stronger or better adapted survive, while the weaker or less adapted go to the wall, are starved out of existence. . . . Each root is striving with all its might to fix itself under ground in the best position; each leaf and stem is struggling hard to overtop its neighbor.”

ANIMALS MUST STRUGGLE, TOO.

There has always been, and still is, among animals as among plants, a similar struggle for means of living

and to give the young a fair start. It is true that it is not actually felt by individual animals, except perhaps among the very highest, where, for example, in a winter, wolves or a band of wolves, must literally fight off other hungry wolves in order to get the eating of some prey they have killed; but it goes on all the same. Here, also, nature's great command to leave as many descendants as possible causes the birth of many more young than there are parents. The world is now, and apparently always has been, just as full of animals as there is room and food for—even more so. Every nook and corner of all the lands and all the oceans free from ice-caps, even to the caves in the rocks and the soil under our feet, abounds in a vast variety of hundreds of thousands of kinds, millions of individuals—of living and active creatures. The population is all that the world can support; it is as much as the average animal, large or small, can do to preserve its life long enough to produce young to follow it; and it is certain that on the average no more of each year's young can survive to maturity than suffices to replace the annual loss by death.

Yet in all but a few of the most highly organized animals, such as the mammals and some birds, many times more young are produced each year than the pair or two which on the average can alone survive. If every cod or shad in the roe of one of these fishes developed into a mature fish the sea would soon be a compact mass of shad and codfish. A single pair of tent-caterpillar moths will leave behind them in the fall, eggs from which enough caterpillars may hatch to fill a pint-measure, yet there are no more of these moths next year than the year before. The average clutch of the game-birds and waterfowl is probably at least eight eggs, which, if all hatched into chicks, and these grew into partridges, ducks, plovers, etc., would in a single year increase the game-birds of the country four or more times; but sportsmen have never noticed anything of the sort.

Why, then, when on the average only two offspring can be expected to live to become parents themselves, are so many more eggs or larvæ or young produced each year than are needed?

Now we can not answer any question *why?* in this matter. A question in that form seems to imply that the thing asked about has been arranged, or is being carried on, by some intelligence for a particular purpose. We do not know whether this is so or not, so we can not answer "why?". We can, however, point out, some facts which show that the unsuccessful or "lost" mass of offspring is not wasted when, for example an oyster pours out a quarter of a million eggs or so, from which perhaps only two or three grown oysters will result; or when a mother mouse gives birth to a dozen or fifteen mouselings a year, although only a pair is needed to fill the gap left by the death of the old ones.

WHAT BECOMES OF COUNTLESS EGGS.

In the first place, vast out-pourings of spawn are (with the exception of some fishes) from very lowly denizens of the sea bottom, whose eggs are thrown off with the same ease and prodigality as are the seeds of the poppy plants mentioned a moment ago, and most of it is at once eaten. In the case of fishes which spawn in the open sea or in swift rivers, the hazard against any surviving at all is tremendous. Think, for a moment of the chances against a cod's egg thrown out on the Banks of Newfoundland. To begin with, many a one is defective and would not hatch anyhow. Then, every fish, big and little, every squid, jellyfish, and what not, is glad to swallow a fish-egg, when accident sends the tiny drop to its mouth. Slowly it sinks down to the bottom, where numberless other fishes, more squids, lobsters, crabs, etc., are ready to take it in. Molluscs creep about licking up such morsels. Other molluscs, sea-anemones, barnacles, and so on, are reaching out tentacles to seize the drifting egg, or sucking in cur-

rents in hope that it will be caught in the tiny whirlpool that leads into a hungry little stomach.

Let us suppose that some eggs escape these dangers, settle in crevices where they are safe and finally hatch. What chance have the fry, the baby fishes, at first hardly bigger than flies, and each the only one to be hatched out of perhaps a hundred or a thousand eggs? The same hungry bandits are still waiting. If a baby fish swims out of his crevice he is likely to be caught in some animal trap or seized by horny lips. Little by little, nevertheless, they must venture abroad, revenging themselves by picking up eggs or snatching here and there something smaller even than themselves. In little bands they steal about, when suddenly some foe will dart at a group and scatter it. Let one lag a little, or be weaker and smaller, and it is caught. Only the biggest, swiftest, can dart to the friendly shelter of some rock, or plunge into a concealing cloud of mud. The company is thinned day by day, but the survivors gradually get big enough to take pretty good care of themselves and finally some of them grow into mature, able fishes.

MEANING OF "NATURAL SELECTION."

Now these survivors are the result of a natural selection—that is, they have been picked out as the best of the whole 250,000 eggs or fry by such tests as occur naturally in a cod's life. A constant exercise of ability in quicker dodging and faster swimming, combined with more or less of good fortune, has kept them alive and growing in strength as well as in age, while all their weaker brethren have been lost, just as in a school trial after trial has shown which were the best six for the boat-crew or the best eleven for the foot-ball team. These fish, like those boys, have shown themselves the most fit, and in their success we see two fairly similar examples of the "survival of the fittest" in its simplest form.

It will have struck you by this time that the great mass of eggs and young that failed were not wasted, since practically all were eaten, nourishing myriads of sea-animals and enabling them in turn to contribute more food of the same kind to each other. Of course this is not the whole of their sustenance, even in summer, for the larger are preying upon the lesser ones, and these last subsist largely on the microscopic plants which swarm in the seas.

The same sort of thing is going on throughout the whole animal kingdom in a greater or lesser degree, but the higher animals produce fewer eggs because they are able to place them where they will be fairly safe or else are able to protect and defend them and the young.

Good illustrations of this contrast may be found among the fishes, a class in which we have been describing what seems the expensive method of producing each year perhaps one hundred thousand times as many eggs as are really needed. Nature has found much more economical methods for most of the fishes, especially those of fresh waters. If you will stroll in summer along the shore of almost any pond with sandy shores you will see sunfish and bass, or both, poised near the bottom, each over a saucer-like depression filled with gravel; among the pebbles are secreted a few dozen eggs, which those fluttering fins are keeping clean of mud, while the watchful parent is always on the alert to dart at and drive away any prowling bass or perch which comes too near in hope of a meal of eggs. This pretty scene is an adaptation to the needs of a small and shallow body of water, where such a method of reproduction as that of the cod, or shad or salmon, would be quite impossible. Fishes couldn't stay out of rivers and ponds, and so they have shaped themselves and their habits to suit the circumstances. This change came about by small, slow improvements in each generation, the young always tending to change

a trifle more than their parents, but in the same direction.

Of course in an article like this I can not go to the root of the matter. I have tried to give you some idea of how growth and change are inevitable in a world like ours where nothing is or ever can be at a standstill, from the weather to the latest perfection of animal life or of human knowledge. As the influences and conditions are constantly changing, living things must change with them, or else must give place to the more adaptive.

Indeed—and mark this well—*the one great distinction between living and non-living things in this world seems to be that the former change from moment to moment and the latter do not.*

A LESSON FROM THE HISTORY OF COSTUME.

About this time perhaps some of you may be saying: “You tell us these things, but how do we know you are right? How can you show us that such adapting changes in a race of plants or animals as you describe have ever taken place?”

This is a fair question, and it can be answered in many ways, and has been answered in other books than this; but the shortest and clearest answer possible here is that given by history—the history written in fossils in the vast book of the crust of the earth—and bearing the title Paleontology.

If you were curious to trace the steps by which men’s dress has developed from the girded blanket-like robe and cross-gartered leggings of our Saxon ancestors, or the tunic and sandals of the Roman peasant, to the costume of the modern gentleman, you would go to a library, and search through records from the earliest manuscript down to the last fashion-plate. You would find the more ancient records, few, scanty, and poorly illustrated. You would also find modifications of costume slow and inconspicuous at

first. The men about the court of Charlemagne wore apparel very similar to those of the attendants upon the first Roman emperor 800 years before, and there was no great difference even 500 years afterward. If you stopped to think about this, you would reflect that during all that time men lived in pretty nearly the same way, few of them going many miles from home, or trying to do anything different from what their fathers and grandfathers had done. Consequently, there was nothing to require or set a-going change of costume or of anything else.

But you would suddenly observe, say about the eleventh century, some noticeable novelties, especially in the equipment of men fighting on horseback, for armor begins to appear. Soon the pictures show very elaborate suits of mail and armor, each knight trying to outdo his neighbor (or his enemy) in strength and completeness. In the background of the pictures appear great stone castles and cities girt with lofty walls. Then you begin to see strange, hooked spears and broad knives in the hands of fighting foot-soldiers; and you reason out that these have been invented to destroy the huge horses or haul the armored riders out of their saddles, and you exclaim: "Ah, a special adaptation of old weapons to a new service!"

CHANGES IN WAYS OF LIVING.

A century or so later, your pictures begin to show what you recognize as rude guns, both hand-arms and cannon. Before their balls (for now men could be killed and defences damaged at a distance instead of in hand-to-hand cut and thrust) the armor of the knights became almost useless, city walls fell down, and instead of mobs of men fighting great scrimmages, and then scattering, regular armies arose, and men had to contrive a dress suitable to the new weapons and methods of campaigning.

This great change in methods of war naturally

brought about rapid alterations in ways of living generally. Little squabbling dukedoms united into broad and powerful kingdoms, which kept the peace at least part of the time; printing was invented, schools were opened; voyagers, trusting to the newly-invented compass, discovered America, and learned the sea-road to India; and the growth of freedom and learning, and especially the ambition of spreading business, demanded in men an activity and energy not dreamed of before. Such activity doesn't comport with flowing robes, lace collars and fancy swords, and so the dandified costumes of the leisurely homekeeping men of the 15th century were rapidly simplified into the plain, snug "business suit" we wear today, and the glittering helmet and gaudy uniform of such soldiers as fought at Waterloo and Balaclava gave place to the safer khaki and dull blue of modern armies.

Now, this sketch of the history of our coats and trousers is a capital illustration of what is meant by adaptation in botany or zoölogy, for each alteration in fashion has been due to some change in manner of life which made the old-style inconvenient or uncomfortable or positively injurious. New customs and new circumstances required new manners and new dress. A man who was too stiff in mind to see this and "keep up-to-date" fell behind, and the man of new ideas stepped into his place in that process of adaptive progress which never stops. Evolution acts in human society just as it has done in animal history.

EVOLUTION'S RECORD IN THE ROCKS.

Skilled and studious men during the last century and a half have been digging in the marls and gravels, and prying apart the rocks of the world in order to understand the imprints of plants and animals entombed millions of years ago. They have been able in this stone library to trace the development of style of structure in plant and animal life just as your

poring over books, old and new, taught you the development of fashions in clothes. We hope you will become sufficiently interested to read some work like Scott's *Introduction of Geology*, and then other more special books; for here we can only give you a glimpse of the marvelous riches of knowledge of the natural history of by-gone ages which are now open to your grasp. It is found that the oldest animals known by fossils are the simplest, and marine; and that as fast as lands arose and dried, they were occupied by plants and animals. But no part of the world seems to have remained the same any great length of time, as we count time in geological history, when "a thousand years is but as a day"; for there is incessant disappearance of old forms, sometimes with strange suddenness, sometimes very gradually, but always new forms appear in their place. All the time the continents were growing more stable and better generally, each new sort of creature was, on the whole, an improvement on his predecessors, and, at least in the case of the mammals at the head of the animal kingdom, there has been a steady increase in brain size and quality, as we know by a comparison of the small brain cavity in the skulls of old types with the larger and better accommodations for a brain in the more recent skulls. We could show you this most interestingly in the history of the cats and dogs from the first appearance of these types; and also in the horse. The horses are a very familiar illustration of evolution as shown by fossil animals. You may read all about them in the book *The Life of Mammals*,* together with a similar history of the descent of many other familiar animals, as bears and deer and rabbits.

We shall explain to you as an illustration, however, a less well-known but equally illustrative case—the history of the American camels.

*By Ernest Ingersoll.

OLD, OLD TIMES IN OUR OWN LAND.

The era in which we are living runs back, say 100,000 years, to a time when the greater part of North America was covered with an enormously thick mass of glaciers and snow-ice, just as Greenland is today. First and last that ice-era was, say, half a million years long. But it was preceded by a period geologists call the Pliocene, which was perhaps another half a million years long; and before that was a very much longer period, the Miocene, and before that an equally long one named Eocene.

Let us go back, say three million years, to the middle of the Eocene period and imagine ourselves in the Rocky Mountain region. The mountains were there, although they must have looked different from now, for one reason because all their slopes and valleys were clothed in dense tropical jungles of palms and vines, various forms of banana, and a steamy luxuriance of foliage such as one now finds in Brazil or Ceylon. The great interior valleys and parks were in some cases shallow lakes, but more often, probably, vast morasses and swamps overflowed whenever storms or the melting of the mountain snows sent down an abundance of water. Doubtless there were more wet days than dry, and the soil, even on the ridges, must have been soft and miry. As for the present plains, they were at the bottom of a shallow sea which covered the whole Mississippi basin.

At any rate, all the Eocene quadrupeds had splayed feet, even those which had rather thin legs and hoofs on their toes, and looked somewhat like horses, deer, rhinoceroses, etc. Each had four or five toes on each foot, whereas most hoofed animals now have no more than two that are really useful. The little hind hoofs are just reminders of that time in the Eocene when all four (and sometimes five) toes came to the ground and worked alike.

THE STORY OF THE ANCIENT CAMEL.

Well, among the four-toed ponies and the other beasts living in those hot and muddy forests was a little thin-legged, four-toed animal, hardly bigger than a jack-rabbit. Its teeth were fitted only for chewing soft leaves and juicy herbage, and the bones of its feet were separate. By this time a very slow but pretty steady elevation of the whole western country was taking place, and more and more hard, dry land was appearing, the swamps slowly draining out and drying up, and open grassy plains taking their place. As fast as this went on, animals of many kinds spread out upon the broadening feeding-grounds, among them the creature mentioned above. But after a while (really thousands of years) its fossil skeletons show that its size has enlarged to that of a coyote, and its two middle toes have enlarged and support the whole weight of the body, while the side toes hang as little, half-useless hoofs like those of a pig. Then follow, as we trace the skeletons of this race through newer and newer strata, a constant increase in size, in length and strength of legs, the two central foot-bones becoming bigger and stronger and finally united into a cannon bone, the neck and head lengthening, and the teeth changing to a set suitable for cropping and grinding dry, flinty grasses, while the whole animal must now have looked like a guanaco or llama, which is a cousin of the camel.

A DESERT ANIMAL.

In the Miocene era, there seems to have been a vast extent of rocky, open country in the interior of North America, with a hot climate; but this gradually became cooler, and much of the desert plains became overgrown with bushes and trees suitable to a warm country, but not like tropical jungles. In this time and situation the small camels became the frequenters of sandy deserts, and it was then that they devel-

oped the pads on their feet which are so well adapted to walking in soft sand, and the humps and stomach which enable this animal to stand long thirst and famine. They were of many species, some toward the last bigger than a dromedary, and existed in great herds. Some early wandered southward, and have survived on the plains of Argentina as guanacos, much the same creature as those old ancestral camels of the Miocene deserts of the North. Others wandered north and westward (for in those days Alaska and Siberia were continuous land) and spread throughout central and southern Asia. These grew large and gradually became the camels we know to this day.

There is no doubt about this history for our museums can show a series of fossil skeletons in which change after change can be traced, from the little Eocene beginner down to the great camel of today; and other knowledge enables us to see how each alteration in bones or teeth or feet was due to the demand of changing feeding ground or climate. It would be difficult to get a clearer example of the way animals have descended from ancient and often very unlike ancestors by continual adaptation to changing circumstances, and by the survival of the fittest to live.



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